PROCEEDINGS OF

THE FIRST INTERPROVINCIAL
SOIL AND WATER CONSERVATION TEACHING [illegible]

CONSERVATION PLANNING ON AGRICULTURAL LANDS IN WESTERN CANADA:
TECHNIQUES, TRENDS AND OPPORTUNITIES

December 9-11, 1991

and

COMPUTER TOOLS FOR SOIL AND WATER CONSERVATION

December 12, 1991
Edmonton, Alberta

Agriculture
Canada

Alberta

TJ Harney
23rd June '93

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Convention Inn
Edmonton, Alberta

D.L. Beever and L.C. Marciak (Editors)

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PREFACE

The idea for The First Interprovincial Soil and Water Conservation Planning Workshop was conceived at the Seventh Prairie Soil Conservation Awareness Meeting held in Regina, Saskatchewan on September 8, 1990. John Hermans, Conservation and Development Branch, Alberta Agriculture made the offer of hosting an interprovincial workshop addressing the subject of conservation planning. Staff from the Conservation and Development Branch prepared a proposal to further define the scope of the workshop. The proposal was accepted in principle and an interprovincial group was solicited to organize and plan the workshop. The inaugural committee meeting was held March 6, 1991 in Regina. This meeting led to the establishment of the Interprovincial Steering Committee which developed the workshop content and format. A local arrangements committee carried out the on site preparations.

Planning has been identified as a method for resolving land degradation and resource management concerns. At a conference at the University of Guelph sponsored by the George Morris Centre, May 1990, Joachin van Braun mentioned that comprehensive land use planning is needed to reverse the trend of resource degradation. Planning also reinforced the need for change in policy which would deal with the challenge of adopting sustainability.

The need for planning, whether at the farm level or at the regional/municipal level is the first step in the conservation of our soil and water resources. However what is often lacking is a clear direction and framework to develop soil and water conservation plans. Often the plans are developed in a reactive mode to address an immediate problem or problems. The challenge is to develop a proactive planning activity with a defined yet flexible framework. Another key element in planning is standards. Standards are necessary for meeting minimum requirements and for the transfer of information from one locale to another. It is hoped that this workshop will assist developing the framework for conservation planning for the workshop participants and the readers of this proceedings.

Although the organizing committee prepared a program of speakers with diverse backgrounds, I observed a common theme in each presentation related to the need for good resource management through planning. We as a group in agriculture have emphasized research, extension, data gathering and implementation. It is my view that planning will play an important role in the future to allocate the many resources that serve our individual and societal needs.

Reference: Sustainable Agriculture: It's Policy Effects on the Future of Canada and Ontario's Agrifood System. University of Guelph, Guelph, Ontario.

Leon Marciak

Leon Marciak
Chairman
Interprovincial Soil and Water Conservation Planning Workshop

ACKNOWLEDGEMENTS

The production and successful implementation of a conference and the resulting proceedings of this scale was not an individual effort. Team work was essential. I would like to thank the Interprovincial Steering Committee for their effort in coordination activities within their jurisdictions and working with the committee. The specific individuals are:

Diana Brierley, Soil & Water Conservation Society
Graham Dorn, Saskatchewan Wetland Conservation Corporation
Peter Entz, Manitoba Agriculture
Peter Fehr, Prairie Farm Rehabilitation Administration
Bill Harron, Prairie Farm Rehabilitation Administration
John Hermans, Alberta Agriculture
Rob Kline, B. C. Ministry of Agriculture, Fisheries & Food
Leon Marciak, Alberta Agriculture
Jim Tokarchuk, Prairie Farm Rehabilitation Administration
Hank VanderPluym, Alberta Agriculture

Also I would like to thank the local arrangements committee for their hard work and ideas in organizing the facilities to meet the workshop needs. Their work created a learning and networking environment which was a prime objective for holding this workshop.

Daardi Almberg, Alberta Agriculture
Donna Beever, Alberta Agriculture
Diana Brierley, Soil & Water Conservation Society
Peter Dzikowski, Alberta Agriculture
Tom Goddard, Alberta Agriculture
John Hermans, Alberta Agriculture
Russel Horvey, Alberta Agriculture
Leon Marciak, Alberta Agriculture
Hank VanderPluym, Alberta Agriculture

Any event such as this needs sponsors. I would like to acknowledge the contribution of the Canada-Alberta Agreement on Environmental Sustainability. The Soil and Water Conservation Society, Alberta Chapter, for lending their support for this conference and underwriting some of the costs. Also I would like to note the contribution in kind in the form of manpower and materials from Alberta Agriculture, Conservation and Development Branch.

I would like to thank Ms. Dawn Gara for typing and formatting the proceedings.

Special thanks is extended to Mrs. Donna Beever for administering and managing many of the details of the workshop from the initial organization of the workshop to publication of the proceedings. This conference would not have been as successful as it was without her diligent contribution.

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PROVINCIAL CONSERVATION ACTIVITIES FROM POLICIES TO PROGRAMS

by
Rob Kline
B.C. Ministry of Agriculture, Fisheries & Food

INTRODUCTION

The agricultural land area of British Columbia is restricted to about 5% of the province's total land area. Only 1% of the provincial land area (2,000,000 arable acres of which 50% or 1 million acres occurs in the Peace River district). Much of the agricultural land in B.C. lies along the major valleys, with the exception of the broad lacustrine soil deposits of the central and Peace River districts of British Columbia.

Paradoxically, the 70-80% of the province's agricultural gross product (approximately $1 billion) is produced within the valley regions of southern British Columbia, while being home to about 70% of British Columbia's population. There is intensive pressure for other land uses on the highly productive agricultural land areas of southern British Columbia.

In 1972, the Agricultural Land Commission Act (ALCA) was passed to control the conversion of agricultural land to other non-agricultural land uses. Land quality issues are not directly addressed, but the ALCA provided a land use planning framework that involved municipalities and regional districts in the planning of land uses in relation to agriculture.

To address the issue of land quality, a Soil Conservation Act was re-drafted and passed into law in 1978 (The Soil Conservation Act of British Columbia).

CURRENT CONSERVATION ISSUES & PROGRAMS

The conservation issues affecting British Columbia's agricultural land resource can be summarized into the following list:

- surface and groundwater quality arising from livestock waster and pesticide management
- organic soil subsidence
- soil compaction on highly productive land
- soil erosion

There are several district bio-geoclimatic zones in British Columbia, and some of the above soil and water degradation issues are specific to one zone, while some zones are affected by all forms of soil and water degradation issues. The simplified issues - region matrix shown in Figure 1 indicates the major soil and water degradation issues that are being addressed in each region. Programs and efforts are targeted to address these regional issues.

Figure 1

	Erosion	Issue Impaction	Subsidence	Water Quality
Peace River Region	X			X (surface)
Central Interior				X
Okanagan				X
South Coastal	X	X	X	X

Addressed in each region. Programs and efforts are targeted to address these regional issues.

The programs that have been used to address these issues are:

1. Federal-Provincial Programs
   Agri Food Regional Development
   Subsidiary Agreement 1985-1990 (ARDSA)
   Canada-British Columbia Soil Conservation Program (CBCSCP)
   1991-1994 Provincial Programs
   Agricultural Land Development Assistance Program - Environment
   Enhancement section

These programs are basically aimed at solving the above degradation issues at their source and are predominantly aimed at producers solving these issues on their farms.

NEW LEGISLATION

Due to the intensive pressure being placed on the agriculture community to set standards of acceptable agricultural practice for water quality issues, a code of agricultural practice will be incorporated into the Waste Management Act of British Columbia. These codes of practice will define the acceptable agricultural management practices that, upon adoption, will exempt producers from aquiring a permit.

Acceptable agricultural environment guidelines are being established and discussed with various community groups throughout British Columbia. The commodity groups will become further involved through the development of an Agricultural Environmental Protection Council (AEPC). The AEPC is designed to provide peer pressure to producers who are seen to be in violation of acceptable and defined best agricultural management practices. This is regarded as an important first step in assisting producers to realize that they are potentially in violation of acceptable practices. Using a member of the local agricultural community as a first approach mechanism has worked well in the past to effect change.

BEST AGRICULTURAL WASTE & SOIL MANAGEMENT

BCMAFF Soils and Engineering Branch has been conducting best agricultural waste and soil management plans, primarily in relation to producers who wish to start improving their animal waste management systems, and for those producers who are intending to adopt the use of conservation grain drills on their farm.

Currently, an inspection of the farm is conducted by an agricultural waste management engineer or technician for waste management plan, or by a soil specialist and regional engineer if it is crop residue management and surface water control in a grain farming region (Peace River). Conservation producer groups technicians in the commodity groups are being trained to conduct on-farm inspections and recommend procedures for waste management. This has not been pursued for soil conservation planning.

Some evaluation of the soil conservation planning procedure will occur. It is obvious that the planning process by itself is not overly popular, but the BSMP service has not been widely advertised partly on the basis of a lack of Soil and Engineering Branch staff to allocate this time for plan development. The approach to conservation planning in the Peace River region has been to regard every annually cultivated piece of land as being prone to erosion. Crop residue retention through minimal or zero tillage systems is viewed as the only acceptable management procedure that is adopted and likely to be "maintained" by the producer as part of this normal farm land management. Presently, the BSMP is essentially a check off that the producer understands the concepts of residue retention for soil erosion and water conservation control, and that the producer's field management and goals will complement the use of a conservation drill.

Currently, no standards of residue retention are being applied. Zero or minimum till systems provide adequate protection from most erosive events in the Peace River district. The choice of grain drills has been primarily those that have had zero tillage capabilties. There have been no requests for BSMP's outside of the Peace River district. Soils and options for soil conservation practices are more varied in other regions. The approach to developing conservation plans will have to be evaluated further.

Planning for soil conservation on a regional and municipal level is not likely to be conducted by many regional governments in British Columbia. Municipalities and regional districts use the Agricultural Land Commission and Soil Conservation Act as planning tools for land use in their jurisdictions. Few regional governments view soil conservation as a critical issue. However, waste management, water quality, and livestock odor control are issues that municipalities have taken some local action with. In absence of provincial guidelines, some of the regional government bylaws have restricted agricultural management practices, especially when farms have been surrounded by residential development. The development of waste management modes of practice and the agricultural environmental guidelines will provide a framework within which municipalities can operate.

FUTURE CONSERVATION INITIATIVES

The future initiative in conservation planning in British Columbia will be driven in several ways.

The advent of the federal government Green Plan initiative in the agricultural sector will support current conservation activities. What is less certain is how the Green Plan's $100 million Fraser River Basin initiative will impact the conservation activities of agricultural producers; it could develop new water quality standards that will have an impact on the current land management and livestock waste management practice.

Solid waste and sewage sludge guidelines are likely to become a factor in the agricultural land disposal of these products.

Increasing population will put pressure on certain regions of the province, most notably the Okanagan and South Coastal regions. Competition for land use will drive the type of regulations that are instituted.

In other regions, dispute resolution mechanisms are being developed to establish a concensus approach to land management practice. This is especially in relation to the Crown owned land and water resources which are expected to have multiple uses. Disputes over livestock use of water that is also used for domestic consumption, reduced river flow used for hydro electricity projects that affect salmon fishery habitat domestic, or irrigation, water supply and livestock fencing (barriers) are examples of issues that will involve agricultural land management practices.

The issues that are being addressed now in British Columbia are not restricted just to soil conservation planning, but will require more efforts in an integrated resource management approach. Each region of the province will have varying sets of problems with different degrees of difficulty in achieving a concensus on how to manage and produce solutions to these issues.

Commercial producers will become very involved in these processes, and it will require changes in management for many of them.

The goal of the BCMAFF is to provide mechanisms that will allow producers to change their management practices that comply with new environmental standards while remaining economically competitive.

CONSERVATION PLANNING ACTIVITIES IN ALBERTA

by

John C. Hermans
Alberta Agriculture

INTRODUCTION

Today I would like to provide some history on conservation planning in Alberta and speculate on where we see it fitting in with our conservation programming in the future. I will not be going into detail on specific projects as they will be addressed by other speakers or poster papers. First of all I would like to give you some background on Alberta, especially for those of you who are guests from other provinces.

About 15 to 20 per cent of Alberta's 51 million acres of agricultural land are affected to some degree by soil degradation. Each year wind erosion may affect one (1) to 1.5 million acres and water erosion may occur on more than 1.5 million acres. Salinity affects 1.6 million acres of dryland and 0.25 million acres of irrigated land. Organic matter levels in many of our cultivated prairie soils have declined to 50 per cent of their levels prior to breaking.

Soil degradation continues to increase in extent and severity, although at a slower rate than a decade ago because of improved cropping practices. A number of factors such as cultivation of fragile soils, droughts, stubble burning, summerfallowing, excessive tillage, overgrazing and a poor farm economy have contributed to soil degradation.

BACKGROUND

Alberta Agriculture has had a strong commitment to soil conservation for many years. However, as public concern about soil degradation increased (e.g. Soil at Risk) the Conservation and Development Branch was formed in 1983 by consolidating existing resources to provide a focus for new initiatives. In 1988, the Soil Conservation Act was revised and strengthened to encourage soil conservation practices while providing the authority to prevent and stop soil loss and deterioration from taking place. Also, in 1988 the Department released a new Strategic Management Plan. One of the six (6) goals is, "to promote responsible management of Alberta's soil and water resources". In 1989 two new positions were created, one Soil Conservation Specialist to address municipal soil conservation planning and another for farm conservation planning.

The 68 Agricultural Service Boards (ASBs) serve as agricultural advisory committees to the local municipal government. They play a key role in the delivery of soil conservation programming in Alberta as mandated under the ASB Act. In addition, they administer the Soil Conservation Act and the ASB Agricultural Fieldman is the Soil Conservation Officer. Since they were formed shortly after the Second World War, ASBs have provided an infrastructure for program delivery that is unique on the Canadian prairies. A major advantage has been that they have been able to develop programs that reflect local priorities (i.e. water related projects in the north and wind erosion or salinity projects in the south). Until the Canada-Alberta Soil Conservation Initiative (CASCI), soil conservation budgets for the ASBs were relatively small and activities had to be completed in one fiscal year resulting in projects that were somewhat piecemeal in nature. In addition, projects tended to be somewhat reactive/fix-it rather than proactive in addressing degradation problems.

PROGRAM DEVELOPMENT

The Canada-Alberta Agreement on Soil, Water and Cropping Research Technology Transfer (CARTT) Program, a federal-provincial program which started in 1989, was the first to provide longer term funding (5 years) for demonstrations and applied research. Funding, however was limited and applications were on a project by project basis. A major change in conservation programming came with the signing of the Soil Conservation Agreement in 1989. The CASCI was the first program that required applicants to submit a three (3) year action plan that encouraged a broader range of activities from general awareness to applied research. The Action Plan components included all conservation-related activities and not just activities that were CASCI funded.

The following (Table 1) example of provincial grant expenditures by ASBs and Producer Groups under CASCI demonstrate that planning is a significant component of this initiative.

Table 1
1991 Provincial Grant Expenditures
by ASBs and Producer Groups

Planning	$516,000	25%
Awareness	$481,000	23%
Courses	$151,000	7%
Demonstrations	$736,000	45%
Total		**100%**

The ASB action plan was the first step in developing a comprehensive and integrated municipal conservation plan. Although the action plan development was perceived to be a lot of work for relatively small monies, it was hoped that the planning effort would pay dividends in the long run by delivering targeted and efficient programs.

MUNICIPAL CONSERVATION PLANNING

Conservation planning in one form or another has been practiced by some municipalities in Alberta for several years. For example, some municipalities were involved in surveying the degradation problems in their areas in an attempt to create awareness among their ratepayers of the extent and seriousness of the problems. These surveys can include a very general documentation of wind or water erosion or may include very detailed soil surveys along with soil/landscape maps. Some further interpretations have been done including wind and water erosion potential, dryland salinity, peat soils, and drainage basins. Several municipalities have also been utilizing Landsat Thematic Mapper images to identify the land use patterns.

A survey of ASB activity in degradation surveys was conducted in 1989 at the beginning of CASCI and then again two years later in 1991 after CASCI was in full swing and ASBs had completed their second action plan. The data (Table 2) demonstrate that there has always been considerable interest (82%) in conducting surveys and a significant level of implementation (34%). The level of implementation increased significantly (59%) when CASCI funds became available. It is also interesting to note that the increase was most significant in Regions III, IV and V regions that traditionally were not perceived by producers to have significant degradation problems.

Table 2
Municipal Resource Mapping Survey - 1989 (1991)

Region	Interest In Mapping	Mapping	No Mapping
1	10(10)	9(9)	1(1)
2	9 (9)	5(6)	4(4)
3	8 (8)	1(7)	9(3)
4	7 (8)	1(5)	11(7)
5	11(12)	3(7)	10(6)
6	10 (9)	4(6)	9(7)
Total	55(56)	23(40)	44(28)

Although these surveys are an excellent start, there are still additional layers of information that should be included in a comprehensive and well integrated plan. This color illustrates how each layer can enhance the total picture. As each layer is added the picture becomes clearer and more meaningful. As you can see, however, you do not need all the layers to see the picture. The question then becomes what layers are needed first and in what order is the information required?

In order to assist interested municipalities in developing integrated municipal conservation plans, we set about developing a blueprint that would do the following:

- Identify the necessary information layers,
- Develop procedures for public input,
- Identify standards for collecting information,
- Develop procedures for integrating the information, and
- Develop systems to update and interact with the information.

A Municipal Conservation Plan Pilot Project (MCPPP) was initiated in 1991 in the County of Stettler to test the blue print and serve as a demonstration to other municipalities that may be interested. A Steering Committee was established to provide an opportunity for input by the following partners: County of Stettler, Alberta Agriculture, Agriculture Canada (Prairie Farm Rehabilitation Administration - PFRA), Alberta Forestry, Lands and Wildlife, Alberta Municipal Affairs, Alberta Environment, Alberta Transportation and Utilities, North American Waterfowl Management Plan (NAWMP), Ducks Unlimited, and the Alberta Association of Municipal Districts and Counties (AAMD&C). The County of Stettler was selected because of the strong agricultural community, diverse landscapes, good upland and wetland wildlife habitat, a strong CASCI action plan, and a very supportive ASB. Jim Lore and Associates and Environmental Management Associates have been contracted through AAMD&C to manage the project. Perhaps one of the most rewarding aspects of the project to date has been the positive interaction focussed on a common goal by such a diverse group. Our goal is to complete the project by April, 1992.

FARM CONSERVATION PLANNING

Farm conservation planning is one approach that provides the greatest direct benefit to individual landowners. The plan details the resources specific to a parcel of land and assists the producer in identifying problems, setting goals, and implementing the best land use and production systems according to the various land units on the farm.

Farm plans may vary considerably depending on the physical resources, available machinery, economics, markets etc. The planning process should still, however, provide a framework that will allow a producer to consider various management alternatives that will ensure economically viable sustainable land management. To do this a farm plan should integrate all of the agricultural disciplines and look at more than just the effects of wind and water erosion.

The focus to date in Alberta has been on developing a format and information package to guide farmers through the farm planning process. To achieve this goal, an advisory committee was formed in 1989 that included producers, district staff, regional staff, staff from other branches within the Department and from other agencies. A farm planning manual was completed in the spring of 1990. There was an excellent response to farm planning by the ASB Agricultural Fieldmen and by Alberta Agriculture's District Agriculturists (DAs) and so training sessions to assist them in delivering farm conservation plans were initiated in the spring of 1990. To date, about one half of the Agricultural Fieldmen and one third of the DAs have completed the voluntary training.

In addition to the training a considerable amount of extension material was developed to assist in the delivery of farm plans including the following:

- A farm planning film,
- A conservation planning calendar - tips,
- Conservation practices/controls matrix,
- Overhead presentations, and
- Other materials.

There has been a great deal of interest in farm planning as a means for program delivery by various other branches and agencies. The following represents a few such examples:

- Alberta Public Safety Services has underwritten the cost for the preparation of farm plans in the flood disaster in western Alberta in 1989 (25 plans) and the drought disaster in southeastern Alberta 1990 (220 plans). The plans were delivered through private consultants,
- Ducks Unlimited will be developing some joint plans with an emphasis on duck habitat,
- Gear Up Financially Program will include a component of farm conservation planning in Region I,
- Farm Business Management Branch will be including conservation planning in their total farm management package,
- Conservation 2000 Clubs have found them to be a popular club activity,
- Holistic Resource Management (HRM) members recognize that the planning activity compliments their own objectives and have requested a group planning workshop, and
- Farm plans have been incorporated into several demonstration farms such as the County of Camrose demonstration farm and the University of Alberta Breton Research Plots (i.e. to be featured at the 1992 Breton Field Day).

BENEFITS

There will be many benefits realized from conservation planning. Perhaps the greatest will be the integration of technologies and programs at both the municipal and farm level. This is consistent with current Alberta Agriculture strategies to utilize a systems approach in technology transfer. The inherent efficiencies should result in one truck arriving at the farm gate instead of five (5) and would be particularly important during times of restraint. Planning will also allow the targeting of scarce resources by the producer and all levels of government. Utilization of landscape units will provide a framework for accessing up-to-date information on soil and crop management technology with expert systems.

FUTURE FOR CONSERVATION PLANNING

When we first discussed having a prairie-wide planning workshop, part of the agenda was to share current knowledge and perhaps develop standards that encourage efficiencies and minimize duplication of effort. The other part of the agenda, however, was to develop a strategy for the future. There is no doubt that conservation planning is of interest to many of the 68 municipalities and more than 50,000 producers in Alberta. The challenge will be to determine if we can effectively meet the demand and still maintain a credible product.

In the bigger picture, however, we need to ask ourselves what society is going to demand. Future programming will be focussed on environmentally sustainable agriculture. There is no doubt that the public will require some form of accountability to ensure that tax dollars spent on farm related programs are environmentally positive or at least neutral. Cross compliance similar to the provisions in the United States Farm Bills is one alternative that may be required. If so, conservation plans in one form or another will be required.

We need to determine if there is positive cost/benefit in implementing a plan at both the municipal and farm level. What is the real cost of completing a plan? One might argue that if a farm plan eliminated one tillage operation at three dollars ($3) to five dollars ($5) per acre that they could be produced by private sector consultants and pay for themselves in one year. Are there opportunities for automation in conservation planning? If the conservation plans became a component of municipal or farm management plans, self help programs may allow more progressive individuals to develop effective plans on their own.

SASKATCHEWAN CONSERVATION PLANNING ACTIVITIES

- From Policies To Programs -

by
Graham Dorn
Saskatchewan Wetland Conservation Corporation

INTRODUCTION

Thank you for the opportunity to meet with you.

Mike McAvoy sends his apologies, as he is unable to be here today.

In my presentation I will give a brief historical outline of conservation activities in Saskatchewan and provide a look at our current activities.

BACKGROUND

Resource conservation in Saskatchewan has been an issue and concern since the 1930's. The Dust Bowl made us acutely aware just how fragile our soil resource was. Conservation efforts at that time included the Federal Government's formation of the PFRA, and the Saskatchewan Legislature passing the first Soil Drifting Control Act.

The Federal Act which set out the PFRA outlines areas of federal involvement with the provinces and provides a means of entering into agreements with provinces, municipalities and individuals. But only the provinces can legislate management practices on privately owned lands within their boundaries.

The Soil Drifting Control Act gives a Rural Municipal council, upon receipt of a petition signed by 40 resident taxpayers and a vote approved by 3/5 of those voting, the power to pass bylaws providing for the prevention and control of tillage practices which, in the opinion of the council, are likely to cause rapid soil degradation by wind erosion. The bylaw may contain provisions requiring certain soil conservation practices be adopted, restricted, or prohibited. If a landowner fails to obey the Act, the municipality may enter the affected lands and perform the required work, adding the costs of the work to the land taxes.

The Soil Drifting Control Act, while it empowered Rural Municipalities to take control into their own hands, was not very effective or frequently used. The Second World War and a return to more "normal" weather patterns drew attention away from events of the 1930's.

Following the War there was a renewed public interest in the agricultural welfare of Saskatchewan. The Conservation and Development Act was passed in 1949, establishing three divisions: water rights; irrigation and drainage; and operations. Assistance was provided for erosion control; water stabilization projects; pasture land reclamation; maintaining, designing and planting shelterbelts; eradication of insect and weed infestations; development of under utilized areas; and reclamation of misused lands for whatever purpose they may best be suited. Conservation Districts currently manage, under authority of Saskatchewan Water Corporation, water conveyance and control structures.

The early 1980's brought another renewed interest in management of the agricultural natural resource. Declining productivity and increasing costs sharpened financial management skills. Several weather induced wind erosion events riveted everyone's attention on the issue. Senator Sparrow took a ride in a light aircraft, and Soil at Risk was born.

International, provincial, and local conferences and workshops were held, focusing on soil and water conservation, tillage management, soil conservation strategies, soil erosion and land degradation, and others.

The PFRA supported the formation of local soil conservation clubs in the early 80's. A Federal-Provincial-industry Soil Conservation Project was initiated in East Central Saskatchewan in 1986. The Saskatchewan-Canada Sub-Agreement on Agriculture under the ERDA Agreement was signed in 1987, making the first Save Our Soils Program available province-wide. By 1988 soil conservation groups had formed in a representative sample of extension districts.

A group of soil conservation minded producers from Saskatchewan made a bid to hold the 1987 Manitoba-North Dakota Zero Till Conference in Regina. Over 1000 attended, and the Saskatchewan producers voted to establish their own organization. The Saskatchewan Soil Conservation Association (SSCA) held their first annual meeting in Saskatoon in 1988. Producer support continues to grow, and in 1989 the SSCA was contracted to deliver the extension, education and awareness component of the NSCP Save Our Soils program. The SSCA contract is in support of the extension program delivered by Saskatchewan Rural Development Extension Agrologists.

The ERDA soil conservation initiatives focused on increasing producers awareness of the soil degradation problem and offered technical assistance and financial incentives to implement on-farm soil conserving practices. ERDA introduced the concept of planning farm operations in a conservation friendly way.

At the same time universities and researchers increased their attention to soil conservation related research and associated extension. Provincial extension efforts also directed additional attention to the soil conservation issue.

CURRENT SASKATCHEWAN ACTIVITIES

Regional and local salinity investigations have been conducted by the University of Saskatchewan and the PFRA since 1984. Detailed salinity control plans have been prepared for some 350 producers, with most producers making the recommended land use changes. Success has been limited by difficulties with forage establishment.

Some PFRA staff have prepared district conservation guidelines, and have prepared group or individual plans on a limited basis. Extension personnel and technicians have found these general guidelines useful, although implementation of land use changes has been limited by current economic conditions and technical resources. PFRA and Saskatchewan Water Corporation have prepared some 100 gully erosion plans on an as-needed basis.

The Saskatchewan Institute of Pedology has increased their activities, completing updated detailed soil surveys in a large part of the province. They have used this information to produce specialized soil resource and land use maps, and to develop a digitized detailed quarter section database (Landbase). This information will ultimately be available in a GIS format.

Research activities under way include evaluating yields (with and without added fertilizer) on fields with variable topsoil depths and degrees of erosion; refinement of the CENTURY organic matter prediction model; and an assessment of the dollar value of topsoil, using existing recent research data.

Recent public task forces on resource management and the economy have identified the importance of minimizing agriculture's impact on the environment. Soil management must not only protect the soil for future generations, but must also minimize negative effects on other natural resources such as water, wetlands, and wildlife.

The Canada-Saskatchewan Agreement on Soil Conservation was signed in July 1989, and the Save Our Soils Program announced in October 1989.

The Agreement on Soil Conservation concept of conservation was broadened to include soil, water, wildlife and wetlands. An increased emphasis was placed on integrated conservation planning.

Regional Conservation Teams (RCT's) were assembled in each of the provinces 6 regions from field staff representing Saskatchewan Rural Development, extension and lands; PFRA area conservationists; Saskatchewan Soil Conservation Association; Saskatchewan Parks and Renewable Resources, Wildlife Branch; Saskatchewan Soil Survey; Agriculture Development Fund; and Ducks Unlimited. These teams compiled a multi-discipline conservation plan for their region, and assisted the ADD Board districts within the 6 regions to prepare their district conservation plans and review producer SOS applications to the Boards. Producers were required to complete a rudimentary conservation plan as part of the Save Our Soils application process. The 6 Regional plans were compiled into a Provincial Conservation Plan, which identified soil and wildlife conservation areas of concern.

Producers who had participated in the ERDA soil conservation groups indicated they wanted more than the demonstrations offered by the Save Our Soils program. Producers and bureaucrats recognized conservation demonstrations often failed due to a lack of technical planning. Awareness of the function and value of conservation planning was increasing in producer, government and academic circles.

Producers in District #11 (south-west Saskatchewan) approached their RCT with the idea of soil conservation planning. The idea was refined, and in the winter 1990/91 group conservation planning pilots were conducted with six groups.

The ADD Boards identified the groups of producers interested in conservation planning. Producers were grouped on similar soils within their Rural Municipality, similar to ARA's. Thematic maps were prepared on soil resources and erosion risk, and critical wildlife habitat. Aerial photomaps, CanHELP erosion prediction software and the LandBase digitized quarter section database were obtained. Groups of approximately 5-8 producers met with a resource team from PFRA in municipal and other rural offices. The resource staff outlined the soil formation, structure and other properties unique to each group of producer's soils. Erosion risk was explained, and examples of how cropping and tillage can effect erosion were presented. Producers then selected one of their quarter sections, and the photomaps, LandBase and CanHELP were used to demonstrate how various cropping and tillage regimes could affect erosion potential. Producers discussed the changes in erosion potential which could be realized by minor changes in farming practices. Rudimentary conservation plans were made, and the Save Our Soils program was outlined.

Producers developed a set of basic conservation principles for their own land, for implementation in the 1991 growing season. The projects were monitored during 1991, and evaluations and refinements will be completed this winter.

In September 1990, the Soil Agreement Management Committee (AMC) struck a committee to investigate on-farm conservation planning. A primary concern of the AMC was the cost of conservation planning, in terms of both human and financial resources. Representation included federal and provincial central and field staff, the producer based Saskatchewan Soil Conservation Association, and a producer member of the Save Our Soils Steering Committee.

This committee was given four tasks:

1. To evaluate soil conservation planning methods, concepts resource requirements and achievements in other jurisdictions.

2. To undertake a user needs assessment of Saskatchewan producers for soil conservation plans.

3. To recommend suitable soil conservation planning methods.

4. To develop a useful soil conservation planning package (if so required by the AMC).

Producer interest in the concept of conservation planning continued to grow. In July 1991 the ADD Board chairpersons and Save Our Soils chairpersons were surveyed to determine their views on the needs and attitudes in Saskatchewan to soil management planning. The survey respondents clearly indicated producers will adopt and apply soil management practices if the planning information is provided. Group planning was preferred; respondents strongly advised producers should pay some of the costs; planning should be universally available; and environmental impacts be considered. There was strong support for compliance (implementation of a conservation practice to receive SOS program benefits) and cross-compliance (implementation of a conservation plan to receive benefits from agricultural support programs), although enforcement was identified as a concern.

The committee quickly discovered conservation planning means different things to different people. It was agreed that conservation planning must consider farm and non-farm issues, and must be holistic in scope. Conservation planning must consider economics and the environment in addition to soil conservation in order to maximize benefits to the producer and society as a whole.

The main conservation planning recommendations included: group planning for group dynamics reasons; planning should be integrated with existing and new agriculture, forestry and wildlife management programs; planning should be voluntary; the cost:benefit of conservation practices need to be quantified; the cost of district/municipal plans should be borne by government, while group and indivudal plans would be cost shared; additional tools such as computer programs need to be developed; pilot projects should be undertaken in each region immediately for implementation and evaluation in 1992; a Soil Management Planning Implementation Committee should be formed immediately to develop a Soil Management Planning program for implementation under the Green Plan in the winter of 1993; district/municipal plans should be developed by RCT's; group and individual plans be developed by technicians supervised by the RCT; and ADD Boards help identify clients and target areas, and administer the program to help producers implement their plans.

Recommendations were presented to the Soils Agreement Management Committee on November 12, 1991. The recommendations are currently under review by the AMC, and will be dealt with at their next meeting, to be held in the new year.

PROVINCIAL CONSERVATION PLANNING ACTIVITIES FROM POLICIES TO PROGRAMS

by
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Manitoba Agriculture

INTRODUCTION

With the support of the farming community, the tax payer, and all levels of government we are in an excellent position to seriously address soil and water conservation issues. In Manitoba we have forty-four local soil and water conservation groups covering all of Agro-Manitoba delivering a program targeted to soil conservation. They are involved in various activities ranging from establishing forages, planting trees, and a boom in the reduced tillage area. Along with that they are active with grassing down gullies, building small water retention structures, rotational grazing programs, establishing forages for salinity control and other projects that are unique to their specific area.

THE PHYSIOGRAPHIC SETTING

The agricultural areas in Manitoba can be defined by the Manitoba Lowlands which include the Interlake, the Red River Valley and the Lower Assiniboine Delta, and the Western Uplands which include the Plains the Till Plains and the Hills. Separating the Manitoba Lowlands and Western Uplands we have the Manitoba Escarpment running diagonally across the province.

THE NATURE OF AGRICULTURE IN MANITOBA

The nature of agriculture in Manitoba is defined by approximately 19 million acres of farmland with slightly over 13 million acres of improved farmland, over 1 million acres in summerfallow and 6 million acres in hay and pasture (see table 1). The significant statistics in this table are the 1.1 million acres of summerfallow and the acreage of special crops, potatoes and sugar beets, which tend to leave the soil subject to wind and water erosion. In terms of livestock numbers the province has slightly over 1 million cattle, 1.25 million hogs and a dairy, sheep and lamb industry.

The most important resource is the people managing the land (27,336 farms in Manitoba). There are 22,869 family farms, 3,229 partnerships and a trend towards family corporations, which now stands at 1,035. The implications of that to conservation planning are that as the farm size increases planning will consider a larger land base. Coupled with that is the current insecurity of income which is effecting decision making on land management issues.

THE ISSUES

Forty percent of cropped acres in Manitoba are at risk from wind erosion and 25% of the cropped areas are at risk from water erosion. One million acres are affected by salinity. Prime farmland is also being lost to non-agricultural development. Another issue that we are faced with is the increase in special crops acreage. Special crops are encouraged because of their ability to break up disease cycles and the cash crop return, however the limited residue that they produce can cause erosion problems.

POLICY

To address conservation activities in Manitoba the place to start is at the Manitoba Round Table on the Environment and Economy. It is chaired by the Premier of Manitoba and has a broad based membership. The Round Table provides direction on various initiatives and strategies.

The working arm of the Round Table is the Sustainable Development Coordination Unit which provides the process for public consultation and results in the development of sustainable development strategies. One of the guiding strategies that Agriculture uses is the Land and Water Strategy in which the public was consulted and we have a document on the summary of public input.

There are six policies in the soil area in the Land and Water Strategy and they are:

1) Soil Quality
2) Soil Moisture Management
3) Saline Soils
4) Environment Protection and Enhancement
5) Land Use Planning
6) Conservation and Education

The policies in the water area under the Land and Water Strategy are:

1) Water Quality
2) Conservation
3) Use and Allocation
4) Water Supply
5) Flooding
6) Drainage
7) Education

Additional guiding documents are the Federal Green Plan, Growing Together, and Proceedings from the Manitoba Consultation Workshop on Agricultural and Environmental Sustainability. The Proceedings, the result of a workshop with the stakeholders in Manitoba enabled the province to prioritize issues as they relate to agricultural sustainability. The priority issues were:

1) The agricultural soil resources
2) Water quantity and surface and groundwater quality.

INSTRUMENTS OF POLICY/PROGRAMS

The instruments of policy in Manitoba are the Canada/Manitoba Accord on Soil and Water Conservation and Development and the North American Waterfowl Management Plan. The working agreement under the Accord on Soil and Water Conservation and Development is the Farming For Tomorrow program. The Farming For Tomorrow program is delivered by forty-four local conservation groups which provide universal access to the program. The key component in this program is the farmers that run these boards and the farmers that carry out these soil conservation projects on their farm. To date, there have been an excess of 2,500 projects completed in Manitoba.

For 1991-92 the Province of Manitoba, along with the Federal Government, signed an Environmental Sustainability Initiative which funded twenty-four projects in Manitoba. This occurred along side the Soil Conservation Agreement but addressed a broader range of issues. This one-year program funded 24 projects. An example of these projects are: evaluating water quality (the Assiniboine Delta Aquifer), examining the effect of forage crops on extracting deep leached nitrogen, integrated pest management and biological weed control, and hay market research. This type of programming provides the Province with a stepping stone to future programs that will be developed under Green Plan initiatives.

Under the North American Waterfowl Management Plan the Manitoba Habitat Heritage Corporation was developed and is charged with overseeing and coordinating the implementation of the North American Waterfowl Management Plan in Manitoba. It is targeted to south west Agro-Manitoba. The strength of the North American Plan is the development of partnerships between the private sector, government departments and land owners. The programs being undertaken include forage establishment, rotational grazing systems, delayed hay cuts, chemical fallow and land leasing and purchasing.

Something unique to Manitoba are the Manitoba Conservation Districts that work within their own mandate as well as linking up with some of the Farming For Tomorrow groups. There are six districts in Agro-Manitoba covering a total of 28% of Agro-Manitoba. They develop and deliver rural conservation programs, and although their prime activity is drainage, maintenance and enhancement, they are active in land management, water storage programs and wildlife habitat maintenance and enhancement.

There are several support programs to these two main initiatives and they deal with anything from protecting marshes to specific conservation activities.

ON-FARM PLANNING

When we start practicing conservation on the farm there is a decision framework that is followed which ultimately effects land use and land management. The first decision of this framework is land use; based on land capabilities - will that land be used in a perennial or native state or will it be annually cropped? Secondly, what type of crops will be grown - will they create high residue or low residue? Thirdly, how will that land be managed in terms of tillage used, types of herbicides used and crop rotation? Fourthly, there are farm management decisions reflecting the short term and long term goals and plans of the farm, the ability to market products and the availability of capital to make changes.

In Manitoba we have developed 2,500 farm plans in the Farming For Tomorrow program. These farm plans had to be completed to access the program. There are several benefits derived from a farm plan. You can clearly identify what the problem is, you can look at a solution or activity that the grower can involve himself in, and I think equally as important, you can look at how conservation can fit in the overall operation of that farm.

The farm planning process, as it stands right now, needs to be looked at very carefully. It tends to be a paper exercise as opposed to a planning exercise. It deals in a more limited basis on one field and one conservation activity, meaning it doesn't take in the complete farm operation. It is my feeling that if farm planning is to be effective it has to consider all of the farm management decisions on that farm. If nothing else, it has to provide solutions to the problems identified by the specialist or farmer. Which means you need a clear payoff for the farmer. They need to see a benefit.

I feel conservation planning is an important component in any soil and water conservation initiative. We need to recognize at what level we want to do our conservation planning. Do we want to plan in a regional context as to what happens in a region or local area, do we want to plan on a farm basis, or do we do both? Ideally, I think we would want to do both of these activities. But, we also have to recognize the time required to do an effective job at either of these activities.

If we have learned one thing in the whole process in Manitoba it is that we have to provide tools to make an informed decision and not a process of just filling in a form. In essence, what we want to do is to provide farmers with the relevant facts to make sound agronomic conservation-oriented decisions on their farm. It comes to a point where maybe that is done on the back of a matchbox or it is just something that you talk about or in fact is a paper exercise in which you sit down and systematically go through a process. I am not sure what the best way to do that is, but certainly the process of farm planning is important. Ultimately however, it is the activity on the field that counts.

We need to be very open minded when we deal with land owners and land managers. Their decision is the one that effects the landscape and we have to be very sensitive to that. Again, we need to provide the best quality of information for these land managers to make their decisions.

TOOLS OF THE TRADE

There are certain tools you need in addressing conservation planning. The most important of which are the people involved in it. The farmers, as well as the people providing technical assistance, must be committed to the process and must be committed to results. They have to have a clear objective as to what they want to achieve. To do this both the farmer and the specialist require technical support in terms of soil survey reports, land use, land capability indexes, an idea of what the potential erosion risk is of certain soil types and a form that will allow the farmer and the specialist to work through the process easily.

IN CONCLUSION

An important part of the workshop, in my mind, is to learn from other people and listen to what we need to do from a government's perspective and what type of assistance the producer is asking for. In preparing for this presentation, I took the opportunity to review some of the historical background in the whole conservation planning area and came upon a report of the Manitoba Soil Conservation Committee of 1946-1947. It struck me as to how much of what we are talking about today is not new. An excerpt from the report goes as follows

> "The chief need appears to be an enlarged educational campaign for the purpose of bringing each farm operator a "knowledge" of the underlying principals of soil conservation and of the soil erosion control methods that are applicable to local conditions, so that each farm operator can plan his operation intelligently."

To conclude, the whole process of on farm conservation planning deals with the ability to provide farmers with the most appropriate technical information that is suited to their needs and their specific problems.

TABLE 1

Nature of Agriculture (1986) Census

Land Base	(000's)
Farmland	19,125
Improved	13,350
Crop Land (Total)	11,150
Cereals	6,600
Flax/Canola	1,900
Special Crops	500
Potatoes	47
Sugar Beets	27
Summerfallow	1,100
Hay and Pasture	6,250

SOIL AND WATER DEGRADATION PROBLEMS IN ONTARIO

by
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INTRODUCTION

The concern for the state of the environment has raised serious questions about the quality of soil and water in the Province of Ontario. Since agriculture is the biggest user of the commodity land, it is natural that most of the attention is focused on agriculture. Although the concerns may be a recent phenomena, the problems have long be recognized by scientists. You only have to browse through some of the scientific papers from the fifties and sixties, to come to this conclusion.

This paper is an attempt to put all these problems into focus and to highlight some of the actions that were undertaken by the Provincial Government to combat the problems. Much of the focus in this paper will be on agriculture although the problems are by no means restricted to this sector alone. Municipal and industrial pollution have led also to the deterioration of the environment.

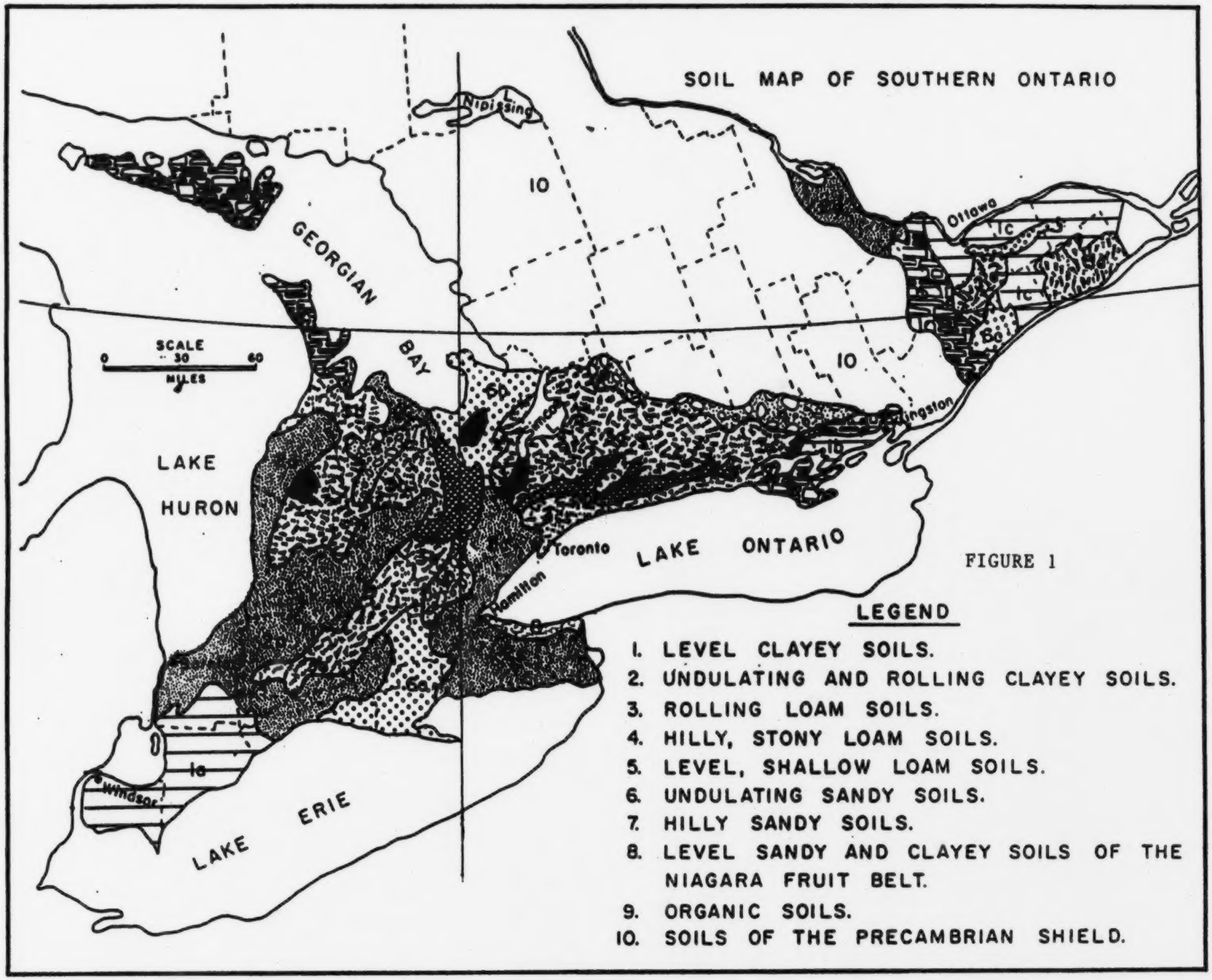
THE PHYSICAL RESOURCES OF ONTARIO

According to the 1986 Census Information, the total area of agricultural land in Ontario amounted to about 4.0 million hectares, of which 95% was located in southern Ontario and 5% in northern Ontario. In discussing the physical resources of Ontario, the focus will be only on the southern portion of the province. The reasons for this is a) that is where most of the agriculture is and b) the resource information for northern Ontario is limited.

In terms of the climate, southern Ontario is characterized by warm summers and mild winters. The average growing season ranges from about 180 days in Algonquin Park to 220 days in the extreme southwest. The average precipitation is the heaviest in the vicinity of Lake Huron and the lightest in the lee of the central uplands in southern Ontario. Corn heat units range from 3700 in the extreme southwest to about 2100 in the central uplands.

Figure 1 is a very generalized soils map for southern Ontario. The central "core" of southern Ontario consists of very fertile predominanatly loamy soils on gently undulating to sometimes rolling lands. In the southwestern portion of the province as well as in the far east, are the clay plains on almost level land. These are mostly glacio-lacustrine deposits. Extensive sand plains can be found bordering Lake Erie and around Georgian Bay and in the eastern part of the province. These sand plains were used for specialty crops such as tobacco and potatoes.

There are about 400 different soil series recognized in southern Ontario, each with their own chemical and physical characteristics. For the layman it is difficult if not impossible to keep track of all these soil series, let alone to know how to manage these soils properly. For that purpose, we developed a system whereby all the soil series in Ontario were grouped into twelve classes based on the surface texture and the natural drainage. Figure 2 provides a summary (in hectares) of these twelve groupings. In the T-2000 project an attempt is being


Nipissing
10
GEORGIAN
BAY
SCALE
0 30 60
MILES
LAKE
HURON
Ottawa
1c
1c
8a
10
Kingston
1b
Toronto
Hamilton
LAKE ONTARIO
5a
6a
1a
Windsor
LAKE ERIE

SOIL MAP OF SOUTHERN ONTARIO

FIGURE 1

LEGEND

1. LEVEL CLAYEY SOILS.
2. UNDULATING AND ROLLING CLAYEY SOILS.
3. ROLLING LOAM SOILS.
4. HILLY, STONY LOAM SOILS.
5. LEVEL, SHALLOW LOAM SOILS.
6. UNDULATING SANDY SOILS.
7. HILLY SANDY SOILS.
8. LEVEL SANDY AND CLAYEY SOILS OF THE NIAGARA FRUIT BELT.
9. ORGANIC SOILS.
10. SOILS OF THE PRECAMBRIAN SHIELD.

made to test and develop appropriate management practices for each of these twelve soil groupings. So far we have developed a recommended tillage chart for each of these groupings.

AGRICULTURAL LAND USE IN ONTARIO

The favourable climatic and soil conditions in Ontario have led to the development of agriculture in southern Ontario. Besides the regular field crops such as corn, small grains, beans, forages, canola, etc. there are also areas with specialty crops such as vineyards, fruits and vegetables, potatoes and tobacco. The latter group can be found most likely in areas where either the right soil conditions exist or in the vicinity of the Great Lakes with their modifying influence on the climate. The figures 4 and 5 provide some information regarding the significance of agriculture in terms of the Gross Domestic Product.

To comprehend the magnitude of the soil and water degradation problems in Ontario, one has to have a good understanding as to how the land is being used as a resource for agriculture. Analysis of Statistics Canada data from 1941 to 1986 provides us with the following picture for Ontario:

- FIG. 6A: AGRICULTURAL LAND USE (TOTAL)
  The total amount of agricultural land in Ontario dropped by 38% from almost 9.0 million hectares to about 5.5 million hectares. The greatest drop was observed in the number of hectares of unimproved land.

- FIG. 6B: AGRICULTURAL LAND USE (IMPROVED AREA)
  The total amount of improved agricultural land in Ontario dropped by 24% from over 5.1 million hectares to just under 4.0 million hectares. The drop in improved land is mainly due to the 68% drop in pasture land (from 1.2 million hectares to just over 400,000 hectares), whereas the amount of cropland remained relatively stable (an overall decrease of only 8%).

- FIG. 6C: AGRICULTURAL LAND USE (UNIMPROVED AREA)
  The unimproved agricultural land decreased by 58% from over 3.5 million hectares in 1941 to about 1.5 million hectares in 1986. There are two land use types listed under the unimproved land use category, woodlots and others. The hectares in woodlots dropped by 73% from 1.5 million in 1941 to about 580,000 hectares in 1986. The "other" category dropped by 54% from 2.0 million hectares in 1941 to about 950,000 hectares.

- FIG. 7: NUMBERS OF FARMS
  The number of farms dropped by 52% from 149,920 farms in 1941 to 72,713 farms in 1986.

- FIG. 8: AVERAGE FARM SIZE
  The average farm size in Ontario increase by 37% from 56 hectares to 78 hectares in 1986.

- FIG. 9: HECTARES OF ROW CROPS vs HAY
  This graph shows the trends for the total area in row crops (these being corn and beans), versus total area under hay crops. The latter can be considered as soil "protectors" against erosion, Whereas the first is not. The trends indicate that over the years the area under hay crops

is dropping by 23% from 1.5 million hectares in 1941 to 1.0 million in 1986. The row crops increased sharply in the sixties, peaked in the early eighties and then started to drop somewhat.

Some conclusions that can be drawn from these figures are:

- although the total area of agricultural land dropped significantly, considering the time span, the acreage of actual cropland remained relatively steady.
- one possible explanation for the relative steadiness of the crop land hectares may be the fact that pasture land was converted to cropland. Pasture land is generally located on the lower classes of land (often associated with the more rolling lands or poorly drained land). This conversion from pasture to cropland may have increased the total potential for soil erosion in the province.
- more and more "dormant" agricultural land such as woodlots may also have been converted to crop land. Since many of the woodlots are located on the more poorly drained lands on the farm, it can be assumed that this accounts for some of the recent wetland losses in Ontario.
- the drop in hay crops over time and the increase in the row crops may have only compounded the seriousness of the soil erosion problem in Ontario. It is also worthwhile to note that while government grants were available for erosion control structures, the number of hectares in row crops increased with time.
- the drop in row crops around 1980 is probably due to the economic situation (sharp drop in the corn acreage) and not so much due to the programs and policies put in place by the Ministry.

NATURE OF LAND AND WATER DEGRADATION ON AGRICULTURAL LANDS

The major land and water degradation problems in the province can be described as follows:

- SOIL EROSION:
  As far back as the fourties and fifties, soil erosion was already identified as one of the major problems facing agriculture in Ontario. You only have to drive once through southern Ontario on a windy spring day just before planting, to experience the "dust bowls" or see the gulley erosion. The bare, "white capped" knolls in Brant county, visible even during the growing season, bare evidence of the sheet erosion that takes place continuously. All these observations have been documented a long time ago. Over the years, researchers at the University of Guelph have studied the causes and effects of soil erosion in great detail.

  Notwithstanding this, the real magnitude of the soil erosion problem became apparent through the works of the International Joint Commission. This commission was established as early as 1909 with the objective "to settle and prevent disputes concerning the use of boundary waters" (as in the Great Lakes). In 1964, the I.J.C. appointed joint investigation boards to investigate pollution problems in Lake Erie and Lake Ontario. In subsequent years we then see the PLUARG studies quantifying the nature and problems of the pollution in the Great Lakes Basin.

Soil erosion was identified as one of the major causes of this pollution problem. In 1981, the Ontario Institute of Pedology published its famous document "CROPLAND SOIL EROSION, ESTIMATED COST TO AGRICULTURE IN ONTARIO", in which the annual row cropland erosion costs were estimated to be about $68 million (both from wind and water erosion). The publication of this report is seen by many as the generator for the OSCEPAP and Land Stewardship programs that followed in the subsequent years.

The regions with the highest erosion potential are those watersheds that enter directly into Lake Erie and Lake Ontario as can be seen in Fig. 10. These are also the regions that have the largest number of hectares in row crops (e.g. corn, soybeans and dry beans).

- SOIL COMPACTION:

Although not as well quantified as soil erosion, insiders rank the soil compaction problem in southern Ontario almost as high as the water erosion problems. A conservative estimate puts the area having medium to high soil compaction problems at about 40-50% of the total land area in southern Ontario. The area that is most prone to soil compaction coincides more or less with the "high" areas shown on the soil erosion map for southern Ontario (Fig. 10).

The roots of the soil compaction problems can be traced back to a combination of the following practices:

- accessing the land with heavy farm equipment under sometimes less than ideal soil conditions.
- excessive tillage operations (oxidation of organic matter).
- deep tillage whereby the organic matter was mixed in with the subsoil (dilution).
- the dominance of mono culture over crop rotation.

All these actions led to a reduction in the organic matter content of the soil. This loss of organic matter caused the inherent soil structure to collapse and subsequently led to an increase in soil compaction.

The most obvious signs of soil compaction are not only the stunted root growth but also the increasing difficulty in tilling the soils, and ultimately the loss in soil productivity. All of these are now common problems that face us in southwestern Ontario.

- ORGANIC MATTER:

The loss of organic matter is definitely a major problem but difficult to quantify. Attempts to calculate the loss of organic matter from soil survey data, puts the number somewhere between 30% and 50% (personal observation). This loss is not isolated to a particular area or soil type, but occurs throughout Ontario wherever excessive tillage and soil erosion occurs.

The loss of organic matter can be contributed for the most part to the same type of problems that led to the compaction problems"

- excessive tillage operations (oxidation of organic matter).
- deep tillage whereby the organic matter was mixed in with the subsoil (dilution).
- acceleration of the erosion process due to the strong increase in row crops.
- less emphasis on crop rotation and more mono cultures over the past decades.

The results of the loss in organic matter content are not only the root problem for soil compaction, but will also have an impact on the soil fertility, moisture holding capacity of the soils and even the workability of the soil itself.

- WATER QUALITY:

The problems with the surface water quality has long been recognized. The Ministry of the Environment developed the standards for water quality a long time ago. The I.J.C. focussed specifically on the water quality of the Great Lakes what has led to the development of standards for phosphates allowed in household detergents. A joint water quality enhancement plan has been developed for southwestern Ontario and the U.S. to reduce the phosphorous loading to Lake Erie. Ontario had to reduce the phosphorous load by 200 metric tons by the year 1990. The Modelling Task Force is still working on the model to prove this point.

The main sources for water pollution from agriculture, besides the siltation from runoff, are the seepage from manure storage facilities into streams, cattle that have free access to stream courses and pesticide spraying and loading sites. Figure 12 shows the areas in southern Ontario which have a high potential for surface water pollution.

An even greater concern these days is the quality of the groundwater in Ontario. Many of the rural population use the groundwater for drinking. This groundwater contamination problem is not only caused by industrial pollution (e.g. the Elmira groundwater contamination problem), but can also be a result from agricultural activities. In a recent report by the Ontario Institute of Pedology to the Nonpoint Source Subcommittee of the I.J.C. it was demonstrated that there are large tracts of land throughout Ontario that have a high potential for groundwater pollution (see Fig. 13) as a result of the agricultural activities.

The Figures 14 and 15 show the agricultural use of herbicides and fungicides in southern Ontario in 1988. Triazine herbicides represented 30% of all herbicides used in Ontario and is used primarily with field crops (field corn). Almost 70% of all fungicides used in the province are applied to fruit crops, hence the high rates for the Niagara fruitbelt and Essex county.

Switching from conventional tillage operations to reduced or even no-till operations to combat soil erosion has raised some concerns regarding groundwater pollution either by herbicides, pesticides or fertilizers. No-till operations are usually recommended for the coarser textured well drained soils, and these soils also form a nice conduit to the groundwater (high permeability). To offset the lack of mechanical weed control, it is not uncommon to spray no-till areas more frequent. Residues of these spraying operations may then find their way quickly to the groundwater. Some of the research at the University of Guelph is now focussing on the nitrogen balance of the soils in Ontario. A major effort is now underway to sample and analyze groundwater from several soils and land use systems across the Province. This information will then serve as a bench mark for future surveys.

Throughout Ontario there are pockets where it is known that the quality of the groundwater is deteriorating rapidly. Only in a few cases was the finger pointed at agriculture, other causes identified were faulty septic tanks, burial of toxic wastes and leaking underground gasoline tanks.

- THE LOSS OF WETLANDS:

The loss of wetland is of great concern not only to the environmentalist but also to the Provincial Government. These wetlands are being viewed as areas that can reduce the risk of floods, act as groundwater recharge areas, contribute to flow augmentation, can be effective in the improvement of water quality (act as a filter), etc. Besides these virtues, wetlands have also a great ecological and educational value. Estimates by the Ministry of Natural Resources indicate that over 50% of Ontario's bird species use wetlands at some time of the year.

In a position statement published by the Ontario Chapter of the Soil Conservation Society of America, it is stated that about 75% of all the original wetlands south of the Canadian shield have disapppeared (either converted to farm land or other uses). In the same paper it is stated that "clearing and drainage due to economic pressures on agriculture account for 85% of recent wetland losses in southern Ontario". Of the remaining wetlands, a great many are being ecologically impaired by partial drainage, excessive siltation, and overexploitation of resources. The figures 16 and 17 show the historic and recent wetland losses in southern Ontario. For many, the loss of these wetland areas in Ontario is critical.

- RANKING THE PROBLEMS:

Without having quantified all the above mentioned problems precisely, it is difficult to put an "importance" ranking on these problems. In the final report of the working group on "SOIL AND WATER CONSERVATION AND DEVELOPMENT" we find a ranking of importance of soil and water issues. For Ontario this list looks as follows:

- soil erosion by water	extremely important
- soil compaction	extremely important
- organic matter	extremely important
- water quality	very important
- soil erosion by wind	important
- wetland	important (?)

Interesting to note that the wetland problems were not even mentioned in this list. The ranking given to the wetlands was done by the author.

REMEDIAL PROGRAMS

All throughout the years, the Ontario Ministry of Agriculture and Food has maintained a rigorous extension program whereby engineers and soils and crops specialists provided valuable advice to the farmers as to how to manage their land and prevent excessive soil erosion. This extension program was at times supported by special programs, whereby farmers could receive grants as seed money to encourage them to change their way of farming. Table 1 summarizes some of the major programs that have been put in place since the end of World War II.

- FARM LAND USE PLANS:
  The objective of this program was to provide the farmers with a detailed soil and land use plan for their farm and to provide recommendations as to how they could improve their management operations. This program ran from 1946 till 1962 and the service was provided by the faculty of the Soils Department of the University of Guelph. Under this program, about 1400 plans were drafted.

- CAPITAL GRANTS PROGRAM:
  This is one of the first "soil conservation" grant programs initiated by the Ministry. Farmers could apply for a grant up to $3000.- for construction of manure storage, drainage installations, field enlargements, well and pond construction and others. Over the length of the program (from 1967-1979), the Ministry paid over $150 million to the farmers. Interesting to note at this point is the item of "field enlargement". Many specialists now promote field size reduction as a means to combat soil erosion.

- TILE DRAINAGE ACT LOANS:
  By the end of the Capital Grants Program, special funds were made available to farmers for tile drainage installations. This program is still active these days. The program is mentioned here since it will increase the timeliness of the field operations and probably can reduce the soil compaction problem.

- ONTARIO FARM PRODUCTIVITY INCENTIVE PROGRAM:
  This program can be viewed as the successor to the Capital Grants Program and ran from 1979 till 1984. Although the majority of the funds were directed towards grants for control structures, manure storage device and watering devices, it was encouraging to see that funds could also be allocated towards demonstrations and education.

- OSCEPAP and OSCEPAPII PROGRAMS:
  The "ONTARIO SOIL CONSERVATION AND ENVIRONMENTAL PROTECTION ASSISTANCE PROGRAM" (both I and II) are the successors to the "ONTARIO FARM PRODUCTIVITY INCENTIVE PROGRAM". The overlap between OSCEPAP I and OSCEPAP II was due to the fact that parts of the first program required the input from engineers but this requirement was dropped after a couple of years. Both "OSCEPAP" programs were still geared towards providing grants for capital structures such as grassed waterways, terracing, manure storage, etc.

- SOIL AND WATER ENVIRONMENTAL ENHANCEMENT PROGRAM:
  The "SWEEP" program is a federal initiated joined program between Agriculture Canada and the Ontario Ministry of Agriculture and Food (based on matching dollars). The area of interest is restricted to those watersheds that drain directly into Lake Erie and Lake Ontario. One of the main benefits of this program is the establishment of the "ONTARIO SOIL AND WATER CONSERVATION INFORMATION BUREAU" at the University of Guelph.

- LAND STEWARDSHIP (I and II) PROGRAMS:
  These programs can be regarded as the first ones that provided grants primarily for soil management purposes. They ran parallel to the "OSCEPAP" programs. The interesting feature here is the fact that although the Ministry provided the funds for the grants, program delivery was in the hands of the ONTARIO SOIL AND CROP IMPROVEMENT ORGANIZATION (farmers organization). Follow-up studies on the delivery mechanism indicate that this is the preferred route by farmers for the delivery of programs like these. At this point in time we also see a re-introduction of a farm plan in order to qualify for the grants. These farm plans have to be developed by the farmers.

- NATIONAL SOIL CONSERVATION PROGRAM:
  This multi facet program initiated by the federal government provides some grants to farmers. The main emphasis for these grants is protecting streams and rivers as well as retiring fragile lands. As is the case with the "LAND STEWARDSHIP" programs, this program is in part being delivered by the ONTARIO SOIL AND CROP IMPROVEMENT ORGANIZATION.

- CLEAN UP RURAL BEACHES:
  This is a program initiated by the Ontario Ministry of the Environment and delivered through the various Conservation Authorities. The areas eligible are determined whether or not the Conservation Authority has a complete CURB plan and is buying in to the plan. The emphasis of the CURB program is on local surface water quality through improved management practices. To qualify for these grants, the farmer has to develop a "WATER QUALITY IMPROVEMENT PLAN" for the farm.

The list that is presented in Table 1 is as complete as can be. There are several conclusions to draw from this information:

- after roughly 20 years of providing grants to farmers we are still having significant environmental problems to solve.

- the grants paid to the farmer is only "seed" money and may not be enough to cure the entire problem the farmer faces.

- for about fifteen of the twenty years, the grants provided were geared specifically to capital investments and only at the end of the 20 year period we see funds being made available to improve the soil management practices.

- research and extension has always been there to provide the farmer with advice.

- farm plans have played a significant role when it comes to soil management issues.

LEGISLATION AND POLICIES REGARDING SOIL AND WATER DEGRADATION

When it comes to legislating soil degradation per se, it must be stated that there are no existing laws that directly govern this aspect. However, there are numerous federal and provincial laws and policies in place that control water degradation and these laws may have an indirect control over soil degradation. For example, there are numerous laws that prohibit the siltation of rivers and streams or the dumping of foreign substances in the streams (e.g. pesticides). It can be reasoned that some of the runoff from farm fields may contribute to this siltation process or even be responsible for dumping pesticide residues in the water. Hence the argument for an indirect control of soil degradation (e.g. preventing excessive soil erosion and runoff from a farm field). Another aspect where the law may have an indirect impact on soil conservation is in relationship to conservation tillage. To offset the tillage operations (no-till applications), the farmer may resort to a more frequent use of herbicides and pesticides. This practice in turn may increase the chances of water pollution and what in turn may trigger the implementation of one of the existing "water control" acts.

Table 2 summarizes most of the federal as well as provincial acts that will control the environmental pollution in the province. The most powerful Acts are probably the "ONTARIO WATER RESOURCES ACT" and the "FISHERIES ACT". Besides these Acts, there are also the "COMMON LAW" and the "AGRICULTURAL CODE OF PRACTICE". The first can be described as a body of unwritten laws based on long standing usages and customs which affects agricultural pollution primarily in the areas of riparian ownership, natural watercourses and underground waters. The "AGRICULTURAL CODE OF PRACTICE" is a white paper that assists farmers in reducing the potential of their livestock operations to pollute air, soil, and water.

CONCLUSIONS

The conclusions we can draw from this information is first of all that we recognize the fact that we have serious soil and water degradation problems. For some of these problems we do not know the full extent and what impact it has on agriculture yet. Throughout the years, the Ministry of Agriculture and Food has provided the necessary grants to entice farmers to put in soil erosion and manure storage facilities in place. Lately, grants have also been made available to change soil management practices. Studies are now underway to determine what impact these programs had on the state of the environment. There are also numerous statutory acts in place that protect the waters in Ontario from excessive pollution. Sooner or later they will exert their influence on the way we will manage our environment.

FUTURE CONSIDERATION TO PREVENT SOIL AND WATER DEGRADATION

What will be the next series of steps to prevent soil and water degradation in the Province? The following aspects may be considered as the logical sequences:

- RESEARCH:
  Although most of the soil and water degradation problems are being recognized in principle, there are still some basic questions to be answered. The various processes that take place, the magnitude of the

problem, as well as the remedial actions to be taken have to be researched in further detail.

- INVENTORY:
  The inventory process has not yet been completed. There will be a continuous need for further inventories of all the resources available. The most comprehensive inventory so far is the soil survey information.

- RESOURCES ANALYSIS:
  More attention has to be paid to an effective resources analysis program. There is a lot of information available already and yet very little attention is paid to it or it is not brought in relationship to other resource materials. The GIS is a perfect tool to do an effective analysis of the information available. Furthermore, there will be a need for modelling processes and to develop expert systems that can be used by extension staff.

- PLANNING:
  Agriculture has to take a more active role in resource planning. So far, we have only taken a supporting approach to land use planning, it is time that agriculture takes a more active role. We have to determine what land is needed to feed the people in Ontario and what land base is required to do so. We have to learn how to manage these resources properly and minimize the impact on the environment. One way to do this is through regional and local farm planning. The regional plan should take an inventory of all the resources available, identify the problem areas and develop "best management" programs to overcome these problems. The farm plans are then the individual action plans which together work towards the goals set out in the regional conservation plan.

- EDUCATION and EXTENSION:
  To make the regional plan acceptable to the farming community requires a dialogue between the rural community and the Ministry. This will require an intensive educational and extension program to bring the message to the community at large.

- MONITORING:
  Inventories are only providing a snap-shot in time, they will not provide information on the rate of change of the resource over time. To accomplish this goal, we have to start monitoring our resources over time. What is required is a series of bench mark sites across the Province which will enable us to monitor the rates of change (soils and water as well as management practices) that will take place over time.

- LEGISLATION and/or COMPLIANCE:
  It appears that there is enough legislation already in place to safeguard the environment. What is probably needed is a buy into the regional conservation plan and some assistance with the farm planning program. One way to accomplish the latter may be through a cross-compliance program.

FIG. 2: TEXTURAL SOIL GROUPINGS

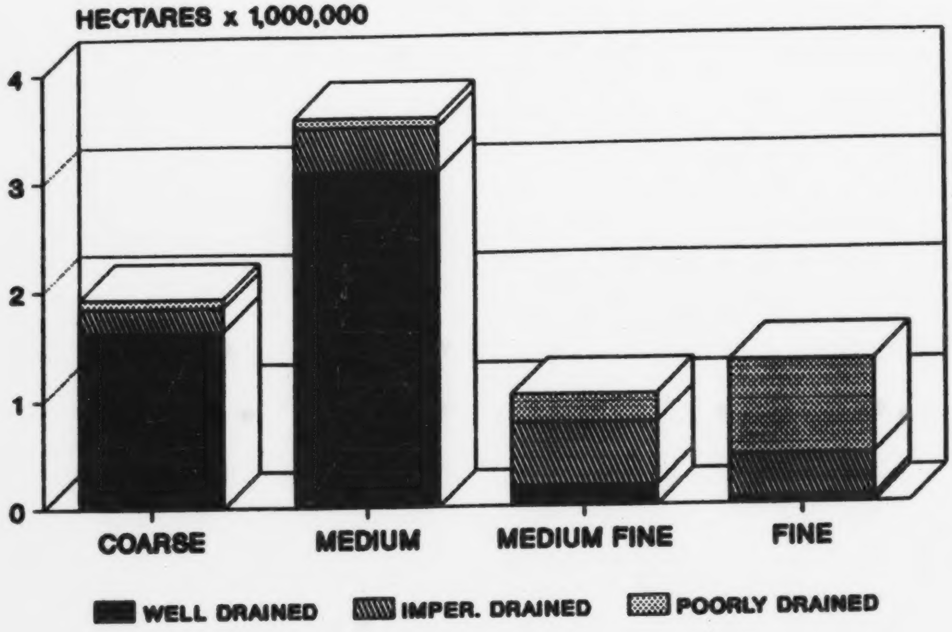


FIG. 3: SOIL EROSION CLASSES.

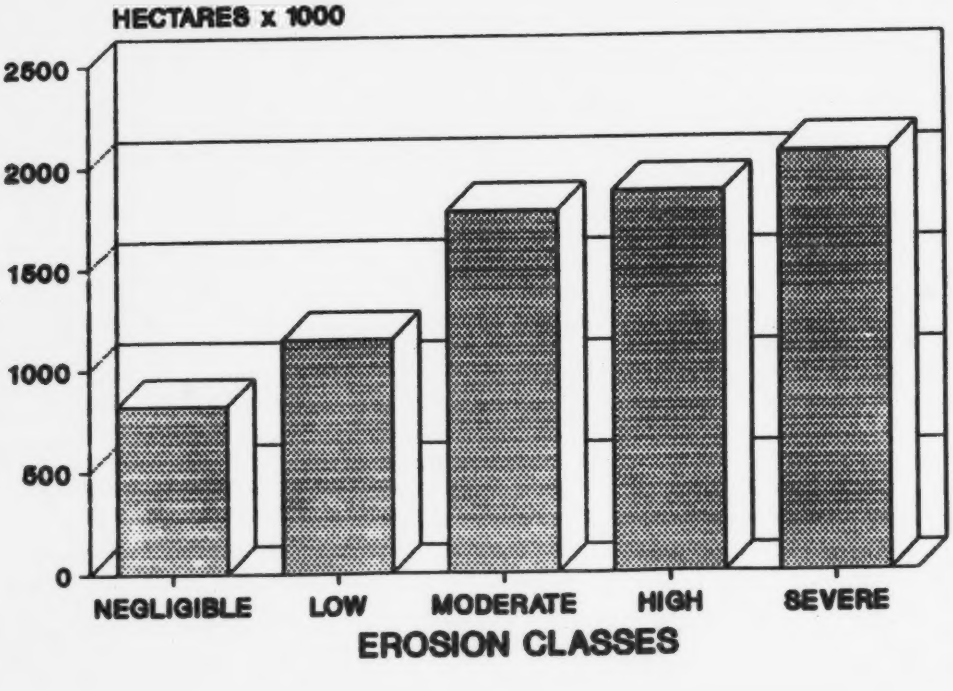
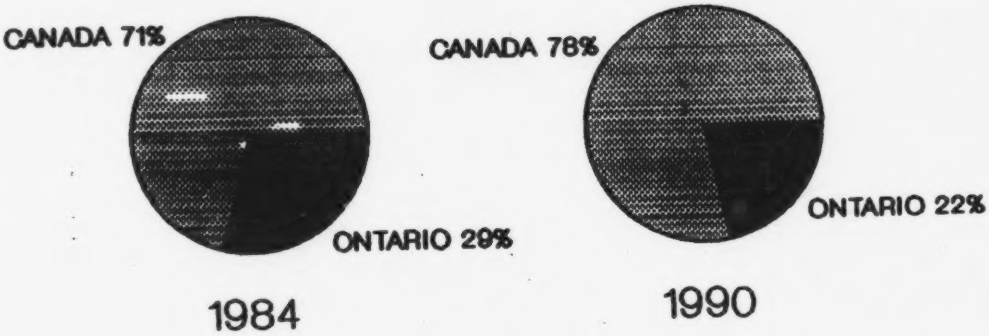
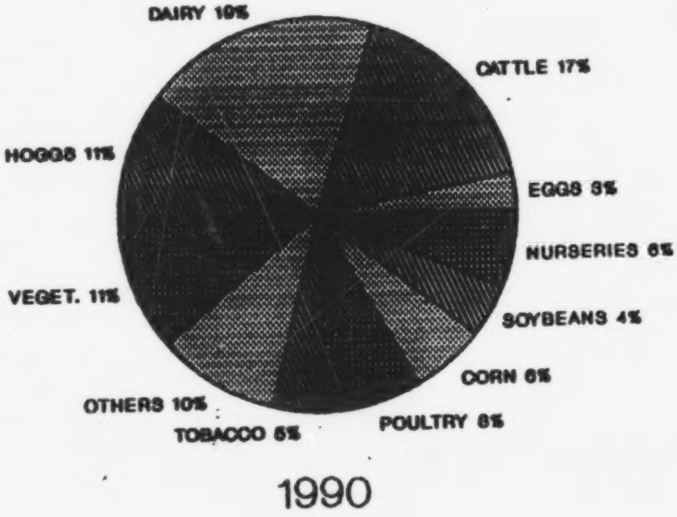


FIG. 4: GROSS DOMESTIC PRODUCT FROM AGRICULTURE.



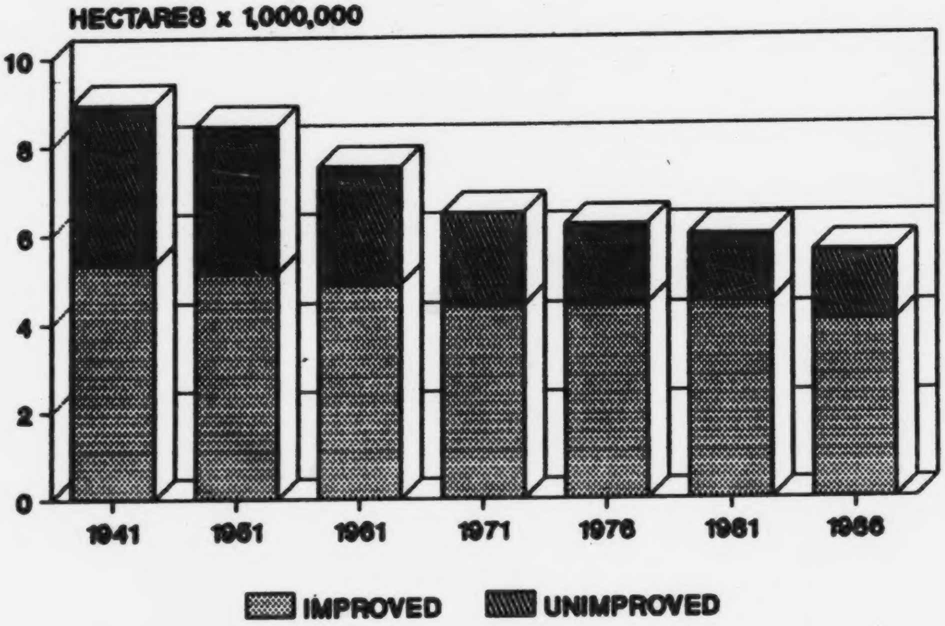
ONTARIO IS SHOWN AS A PERCENTAGE OF THE CANADIAN G.D.P.

FIG. 5: CASH RECEIPTS FOR SELECTED COMMODITIES.



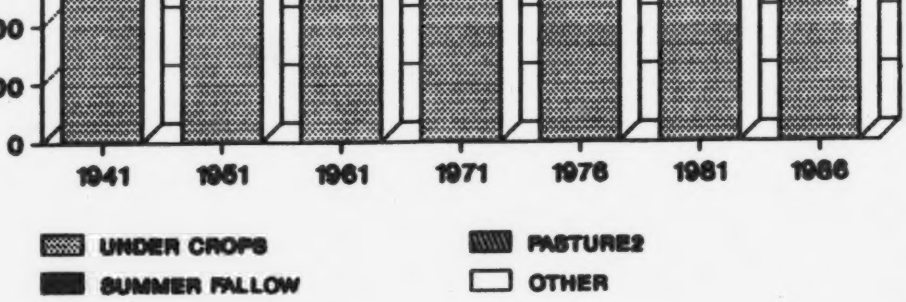
SOURCE: O.M.A.F. STATISTICS

FIG. 6A: AGRICULTURAL LAND USE



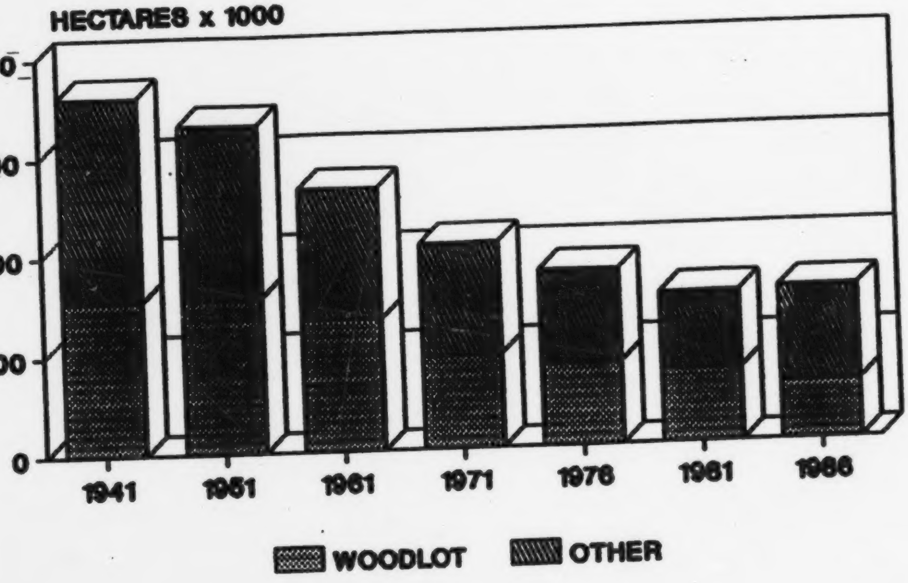
SOURCE: STATISTICS CANADA

FIG. 6B: AGRICULTURAL LAND USE
(IMPROVED AREA)



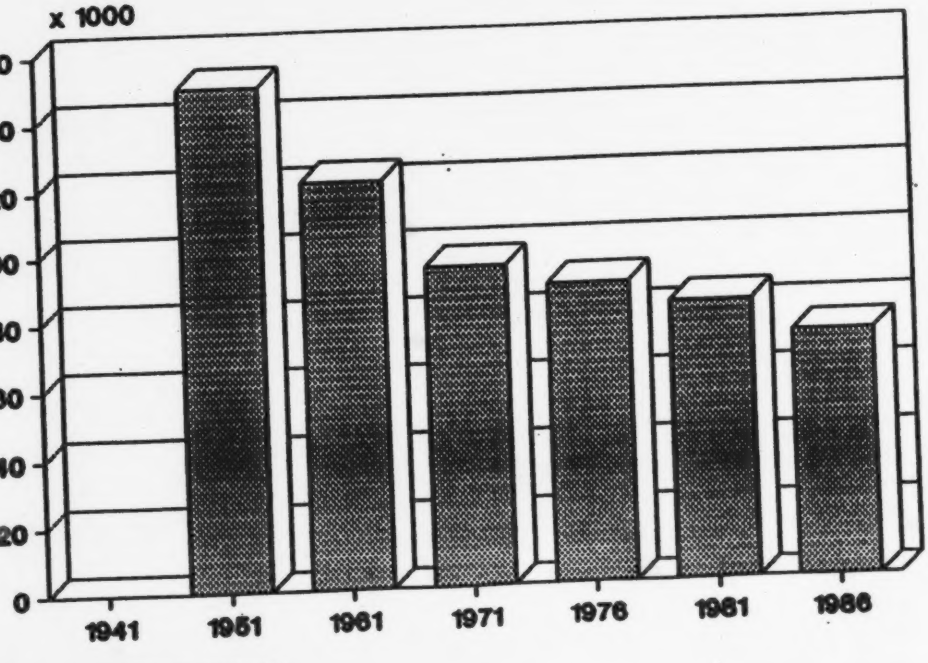
SOURCE: STATISTICS CANADA

FIG. 6C: AGRICULTURAL LAND USE
(UNIMPROVED AREA)



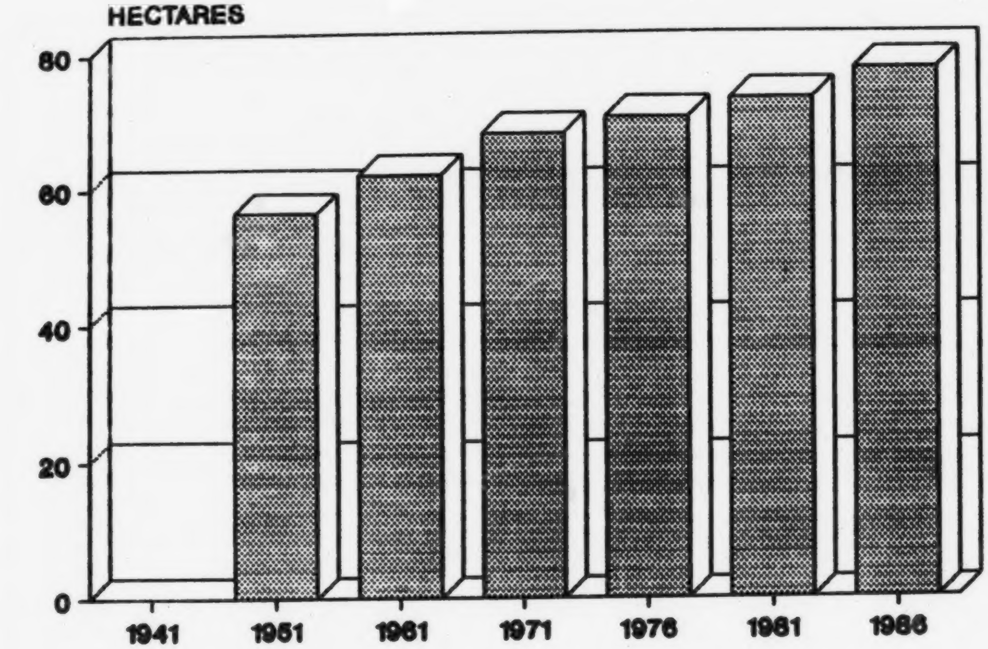
SOURCE: STATISTICS CANADA

FIG. 7: NUMBER OF FARMS



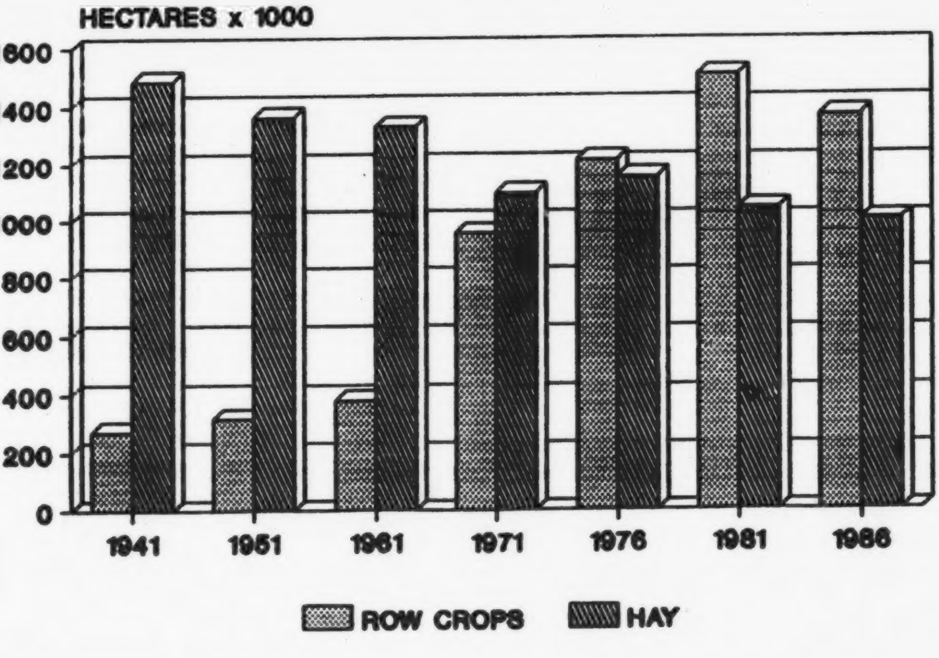
SOURCE: STATISTICS CANADA

FIG. 8: AVERAGE FARM SIZE

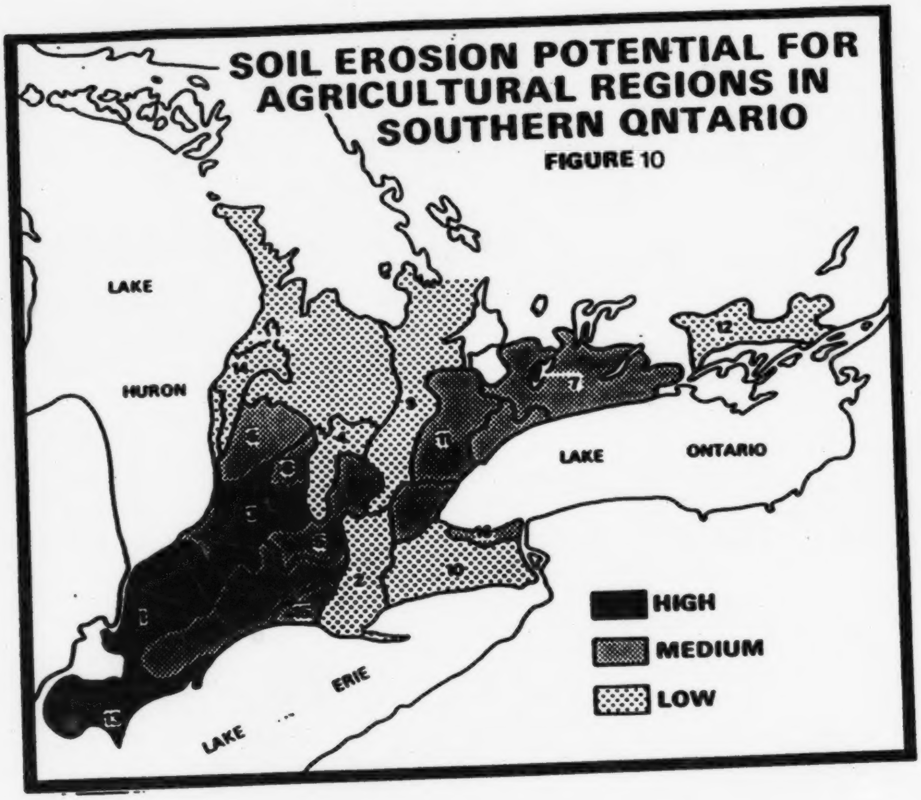


SOURCE: STATISTICS CANADA

FIG. 9: HECTARES OF ROW CROPS vs HAY



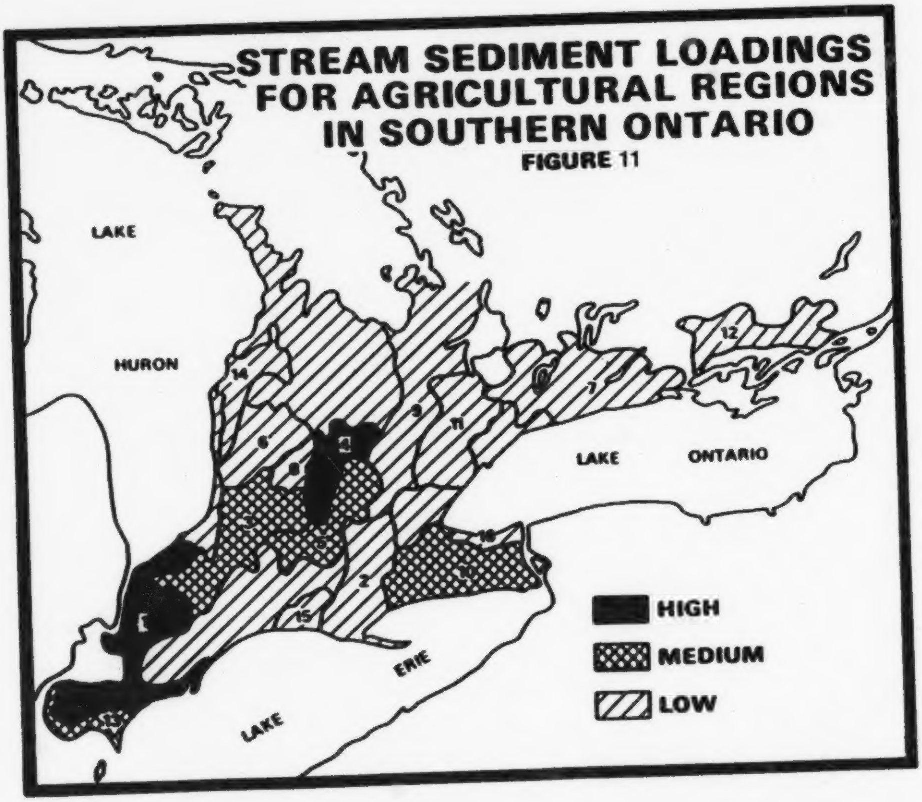
SOURCE: STATISTICS CANADA



SOIL EROSION POTENTIAL FOR AGRICULTURAL REGIONS IN SOUTHERN QNTARIO

FIGURE 10

LAKE
HURON
LAKE
ONTARIO
LAKE
ERIE
14
9
12
7
10
2
HIGH
MEDIUM
LOW



STREAM SEDIMENT LOADINGS FOR AGRICULTURAL REGIONS IN SOUTHERN ONTARIO

FIGURE 11

LAKE
HURON
LAKE
ONTARIO
LAKE
ERIE
14
6
8
9
11
1
12
16
2
15
HIGH
MEDIUM
LOW

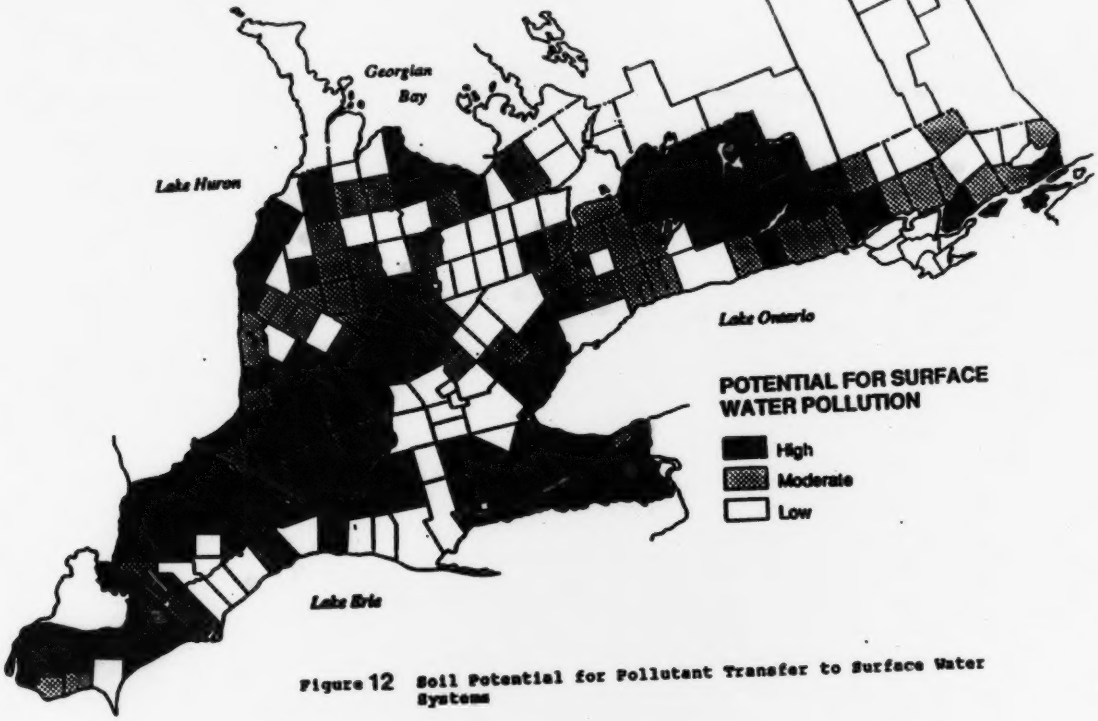

Georgian Bay
Lake Huron
Lake Ontario
Lake Erie
POTENTIAL FOR SURFACE WATER POLLUTION
High
Moderate
Low

Figure 12 Soil Potential for Pollutant Transfer to Surface Water Systems

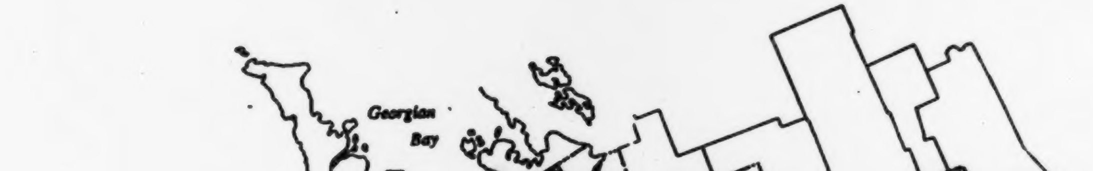

Georgian Bay
Lake Huron
Lake Ontario
Lake Erie
POTENTIAL FOR GROUNDWATER POLLUTION
High
Moderate
Low

Figure 13 Soil Potential for Pollutant Transfer to Groundwater Systems

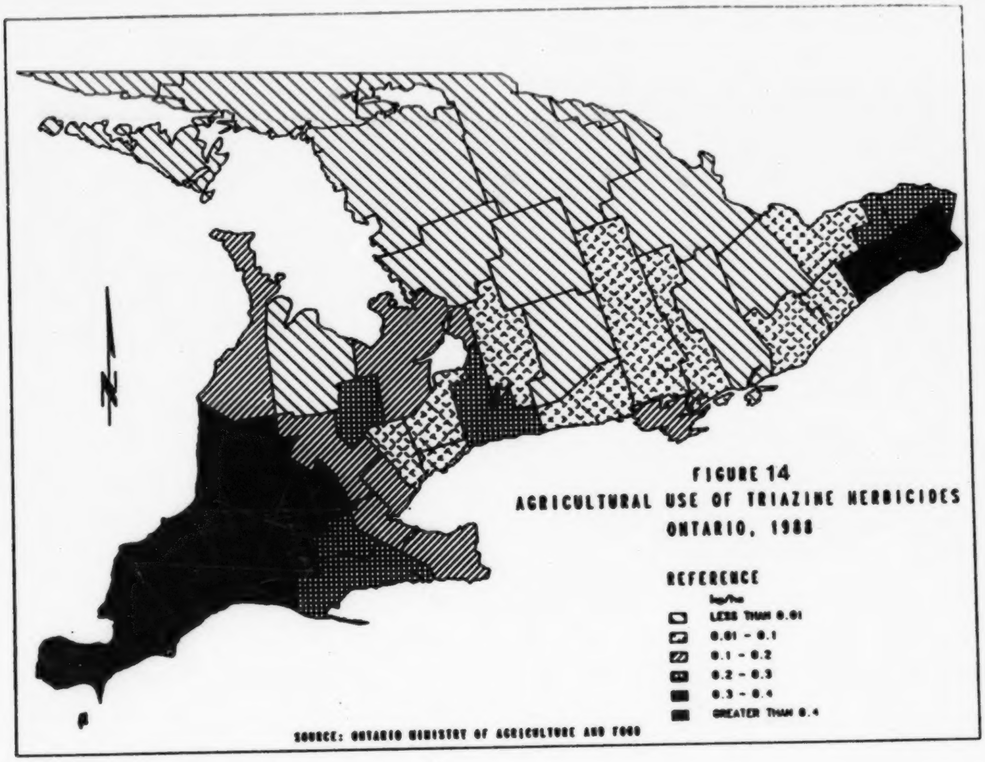

REFERENCE
kg/ha
LESS THAN 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
GREATER THAN 0.4

FIGURE 14
AGRICULTURAL USE OF TRIAZINE HERBICIDES
ONTARIO, 1988

SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD

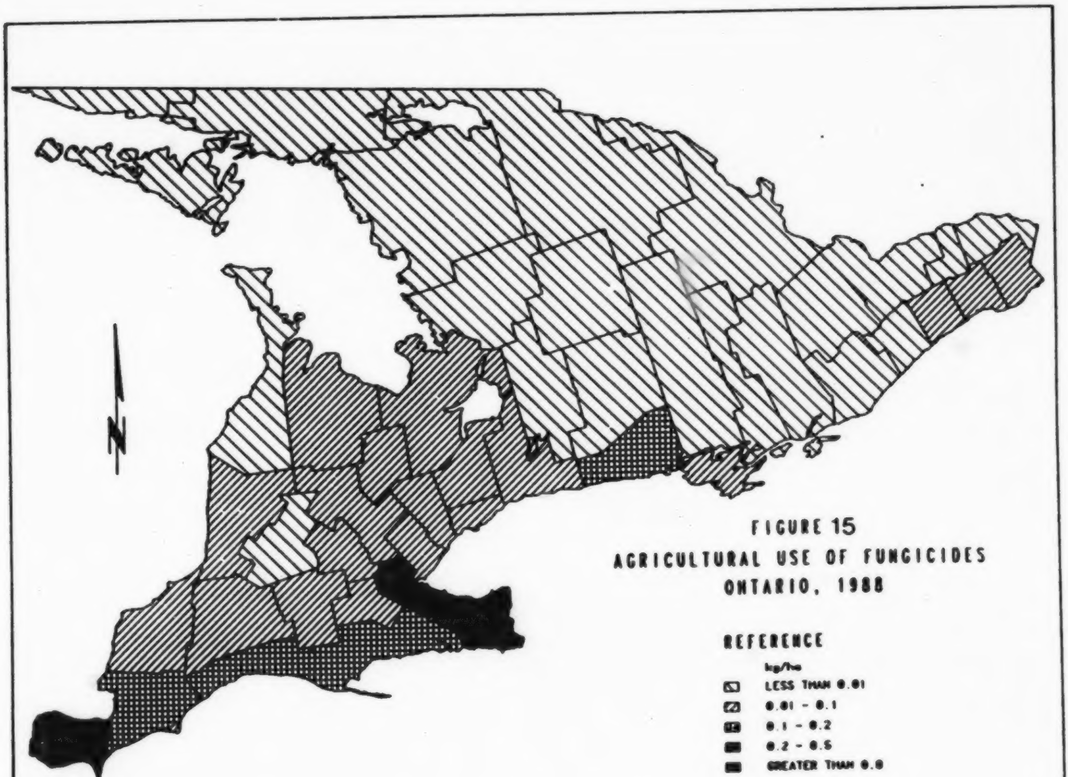
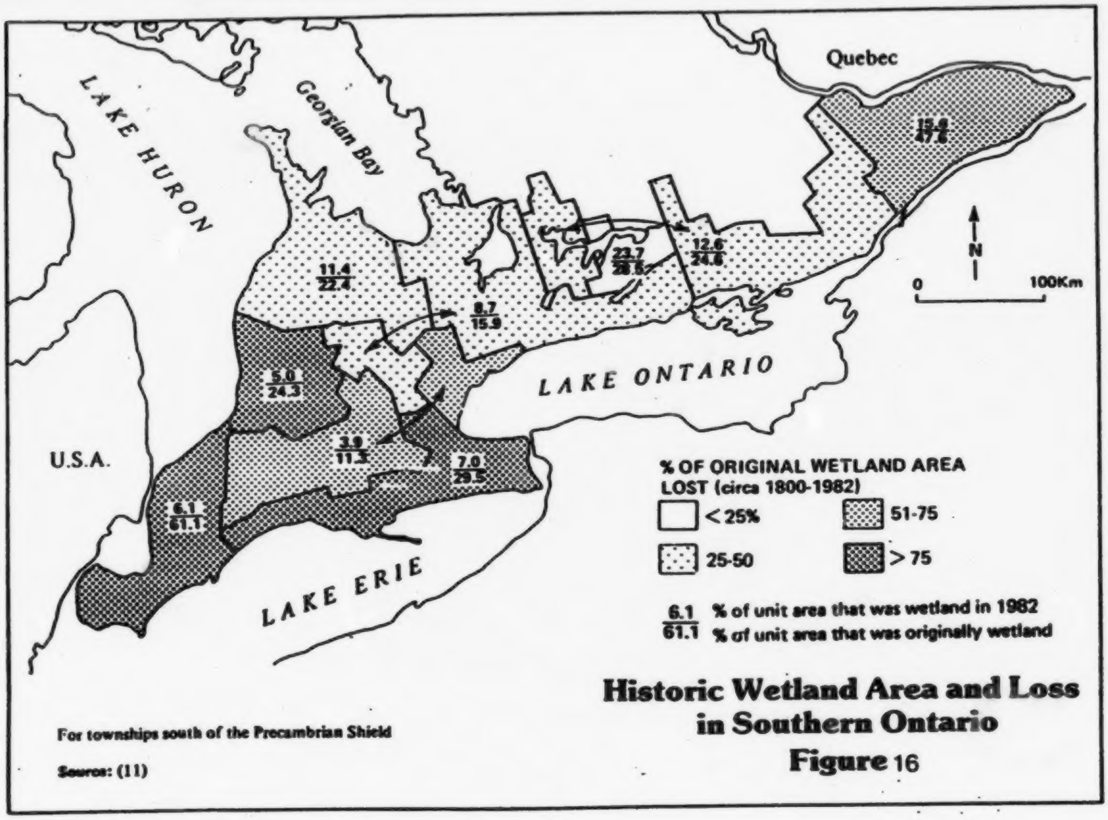

REFERENCE
kg/ha
LESS THAN 0.01
0.01 - 0.1
0.1 - 0.2
0.2 - 0.5
GREATER THAN 0.5

FIGURE 15
AGRICULTURAL USE OF FUNGICIDES
ONTARIO, 1988

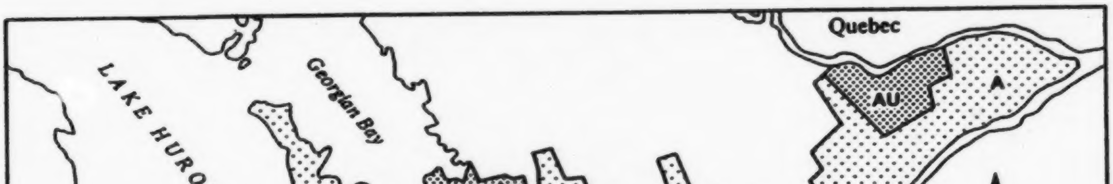
SOURCE: ONTARIO MINISTRY OF AGRICULTURE AND FOOD


LAKE HURON
Georgian Bay
Quebec
LAKE ONTARIO
LAKE ERIE
U.S.A.
N
0
100Km
11.4
22.4
8.7
15.9
23.7
28.5
12.6
24.6
15.6
47.6
5.0
24.3
3.9
11.3
7.0
29.5
6.1
61.1
% OF ORIGINAL WETLAND AREA
LOST (circa 1800-1982)
< 25%
25-50
51-75
> 75
6.1 % of unit area that was wetland in 1982
61.1 % of unit area that was originally wetland

For townships south of the Precambrian Shield

Source: (11)

Historic Wetland Area and Loss in Southern Ontario
Figure 16


LAKE HURON
Georgian Bay
Quebec
LAKE ONTARIO
LAKE ERIE
U.S.A.
N
0
100Km
A
AC
AC
AC
AU
A
A
A
AU
A
UA
LOSS AS % OF 1967
WETLAND AREA
0 – 5%
5.1–10
10.1–30
MAJOR CAUSES
OF LOSS
A Agriculture
C Cottage Development
U Urban Development

*Notes: – Figure shows gross loss without accounting for gains. Most gains are of shrubby swamps often of relatively low value.
– Losses assessed by county (only townships south of the Precambrian Shield).

Source: (11)

Recent Wetland Loss, Southern Ontario 1967-1982
Figure 17

TABLE 1. MAJOR CONSERVATION PROGRAMS IN ONTARIO.

ROGRAM	TIME-FRAME	OBJECTIVE	AGENCY	DOLLARS	DELIVERABLES
OSCEPAPII	1986-1990	TO PROVIDE GRANT ASSISTANCE FOR CONTROLLING AGRICULTURAL SOIL EROSION, SUSTAINING CROP PRODUCTIVITY AND PROTECTING WATER RESOURCES.	O.M.A.F.	$22.0 M.	- SOIL CONSERVATION - MANURE STORAGES - MILKHOUSE WASTE - PESTICIDE HANDLING - OTHER
SWEEP	1986-1992	TO REDUCE THE PHOSPHOROUS LEVELS IN LAKE ERIE; TO IMPROVE SOIL PRODUCTIVITY; TO PROMOTE SOIL CONSERVATION.	AGR.CANADA & O.M.A.F.	$15.0 M.	- WATERSHED STUDIES - TECHNOLOGY R&D PROJECTS - CONSERVATION INFO CENTRE - ECONOMIC STUDIES
LAND STEWARDSHIP PROGRAM	1987-1990	TO PROVIDE GRANTS FOR THE ADOPTION OF CONSERVATION FARMING PRACTICES THAT WILL ENHANCE AND SUSTAIN AGRICULTURAL PRODUCTION AND IMPROVE SOIL RESOURCES AND WATER MANAGEMENT.	O.S.C.I.A. & O.M.A.F.	$40.0 M.	- CROP ROTATION - RESIDUE MANAGEMENT - RETIRING FRAGILE LAND - STEWARDSHIP LEASE - MUNICIPAL DRAINS - CONTROL STRUCTURES - CONSERVATION EQUIP. - TECH. TRANSFER - RESEARCH - T-2000 PROJECT
LAND STEWARDSHIP PROGRAM II	1990-1994	TO CONTINUE THE COMMITMENT TO PLANNED CONSERVATION SYSTEMS AND ENVIRONMENTAL PROTECTION MEASURES.	O.S.C.I.A. & O.M.A.F.	$38.0 M.	- RESIDUE MANAGEMENT - COVER CROPS - STRIP CROPPING - CONSERVATION EQUIP. - CONTROL STRUCTURES - MANURE STORAGE - MILKHOUSE WASTE - PESTICIDE HANDLING

OSCEPAP = ONTARIO SOIL CONSERVATION & ENVIRONMENTAL PROTECTION ASSISTANCE PROGRAM
SWEEP = SOIL AND WATER ENVIRONMENTAL ENHANCEMENT PROGRAM
N.S.C.P. = NATIONAL SOIL CONSERVATION PROGRAM
E.S.I. = ENVIRONMENTAL SUSTAINABILITY INITIATIVE
CURB = CLEAN UP RURAL BEACHES

TABLE 1.

MAJOR CONSERVATION PROGRAMS IN ONTARIO.

ROGRAM	TIME-FRAME	OBJECTIVE	AGENCY	DOLLARS	DELIVERABLES
FARM LAND USE PLAN	1946-1963	TO PROVIDE A COMPREHENSIVE LAND USE PLAN FOR A FARM, WITH AN EMPHASIS ON SOIL CONSERVATION AND SOIL MANAGEMENT.	U. of G.	UNKNOWN	- SOIL INVENTORY - SOIL CAPABILITY MAP - FARM LAY OUT - SOIL CONSERVATION - SOIL MANAGEMENT
CAPITAL GRANTS PROGRAM	1967-1979	A CAPITAL GRANT WAS AVAILABLE FOR SPECIFIC CAPITAL IMPROVEMENTS ON COMMERCIAL FARMS, AS PART OF A LONG TERM POLICY FOR CAPITAL IMPROVEMENTS.	O.M.A.F.	ESTIMATE $150.0 M	- CONSTRUCTION - DRAINAGE - ORCHARD REMOVAL - FIELD ENLARGEMENT - WELLS and PONDS
TILE DRAINAGE ACT LOANS	1978-	IMPROVE SOIL CAPABILITY FOR AGRICULTURE, PROVIDE BASIC DRAINAGE NECESSARY FOR IMPLEMENTING SOIL CONSERVATION AGRICULTURAL PROJECTS.	O.M.A.F. & MUNICIPALITIES	$10.0 M. PER ANNUM	- TILE DRAINAGE SYSTEMS
ONTARIO FARM PRODUCTIVITY INCENTIVE PROGRAM	1979-1984	TO ENCOURAGE FARMERS TO MAKE CHANGES ON THEIR FARMS WHICH WILL IMPROVE SOIL MANAGEMENT AND MINIMIZE SOIL EROSION.	O.M.A.F.	ESTIMATE $12.0 M	- CONTROL STRUCTURES - MANURE STORAGE - WATERING DEVICES - EDUCATIONAL PROGRAMS - DEMONSTRATIONS
OSCEPAP	1983-1988	TO PROVIDE CAPITAL GRANTS FOR ON-FARM EROSION CONTROL PROJECTS AND MANURE STORAGE FACILITIES.	O.M.A.F.	$25.5 M.	- EROSION CONTROL STRUCTURES - MANURE STORAGE FACILITIES.

OSCEPAP = ONTARIO SOIL CONSERVATION & ENVIRONMENTAL PROTECTION ASSISTANCE PROGRAM
SWEEP = SOIL AND WATER ENVIRONMENTAL ENHANCEMENT PROGRAM
N.S.C.P. = NATIONAL SOIL CONSERVATION PROGRAM
E.S.I. = ENVIRONMENTAL SUSTAINABILITY INITIATIVE
CURB = CLEAN UP RURAL BEACHES

TABLE 1. MAJOR CONSERVATION PROGRAMS IN ONTARIO.

ROGRAM	TIME-FRAME	OBJECTIVE	AGENCY	DOLLARS	DELIVERABLES
N.S.C.P.		PRODUCERS CAN RECEIVE FUNDS FOR RETIRING AND PROTECTING FRAGILE LAND, ESPECIALLY FARMLAND STRIPS ALONG ADJACENT TO STREAM AND OPEN DITCHES.	O.S.C.I.A. & AGR.CANADA	$11.0 M.	- BUFFER STRIPS - HIGHLY ERODIBLE/ FRAGILE LANDS - FLOOD PLAINS - RESEARCH
E.S.I.	1991-1992	TO PROMOTE AGRICULTURAL SUSTAINABILITY.	AGR.CANADA & O.M.A.F.	$ 1.8 M.	- RESEARCH PROJECTS - BEST MANAGEMENT PRACTICES MANUAL - WATER QUALITY STUDY
CURB PROGRAM	1991-2001	TO IMPROVE LOCAL SURFACE WATER QUALITY THROUGH IMPROVED MANAGEMENT PRACTICES.	M.O.E. & C.A.	$57.0 M.	- LIVESTOCK ACCESS - MANURE MANAGEMENT - MILKHOUSE WASTE - SEWAGE SYSTEMS

OSCEPAP = ONTARIO SOIL CONSERVATION & ENVIRONMENTAL PROTECTION ASSISTANCE PROGRAM
SWEEP = SOIL AND WATER ENVIRONMENTAL ENHANCEMENT PROGRAM
N.S.C.P. = NATIONAL SOIL CONSERVATION PROGRAM
E.S.I. = ENVIRONMENTAL SUSTAINABILITY INITIATIVE
CURB = CLEAN UP RURAL BEACHES

TABLE 2.

ENVIRONMENTAL LEGISLATION

ACT	AGENCY	OBJECTIVE	IMPACT
		FEDERAL	
CANADA WATER ACT	ENVIRONMENT CANADA	To establish policies and programs with respect to the water resources of Canada and to ensure the optimum use of those resources for the benefit of all Canadians. To set national standards of environmental quality.	Includes prohibition section for deposing waste in water. Where water quality management of any inter-jurisdictional waters has become a matter or urgent national concern, the Minister may designate those waters as water quality management areas and appoint an existing corporation as an agent to perform any function of water management and carry out programs to restore, preserve and enhance the environment.
CANADA WILDLIFE ACT	ENVIRONMENT CANADA	Designate areas for the protection of wildlife and outlines prohibitions on activities within this area.	List activities prohibited in wildlife areas such as use of vehicles, dumping of wastes, disturbances of soil or vegetation, etc.
CANADIAN ENVIRONMENTAL PROTECTION ACT	ENVIRONMENT CANADA NATIONAL HEALTH AND WELFARE	To take preventative and remedial measures to protect the environment. To facilitate the protection of the environment by the people of Canada. To establish levels of environmental quality. To inform the people of Canada on the state of the environment. To endeavour to protect the environment from the release of toxic substances.	Establish and operate environmental monitoring programs. Formulate objectives, guidelines and Codes of Practice.
FISHERIES ACT	FISHERIES AND OCEANS CANADA ENVIRONMENT CANADA ONTARIO MINISTRY OF NATURAL RESOURCES	To protect fish, shellfish, crustaceans and marine animals in all waters in the fishing zones of Canada and all internal waters of Canada.	Minister may require owners of obstructions in waterways to provide channels for fish to pass. No person shall deposit deleterious substances in water frequented by fish.
NAVIGABLE WATER PROTECTION ACT	TRANSPORT CANADA	No work may be undertaken affecting navigable waters unless approved by the Minister.	The Act stipulates that no person shall deposit any material or rubbish into navigable water that is liable to interfere with navigation.

TABLE 2.

ENVIRONMENTAL LEGISLATION

ACT	AGENCY	OBJECTIVE	IMPACT
FEDERAL			
CANADA WATER ACT	ENVIRONMENT CANADA	To establish policies and programs with respect to the water resources of Canada and to ensure the optimum use of those resources for the benefit of all Canadians. To set national standards of environmental quality.	Includes prohibition section for deposing waste in water. Where water quality management of any inter-jurisdictional waters has become a matter or urgent national concern, the Minister may designate those waters as water quality management areas and appoint an existing corporation as an agent to perform any function of water management and carry out programs to restore, preserve and enhance the environment.
CANADA WILDLIFE ACT	ENVIRONMENT CANADA	Designate areas for the protection of wildlife and outlines prohibitions on activities within this area.	List activities prohibited in wildlife areas such as use of vehicles, dumping of wastes, disturbances of soil or vegetation, etc.
CANADIAN ENVIRONMENTAL PROTECTION ACT	ENVIRONMENT CANADA NATIONAL HEALTH AND WELFARE	To take preventative and remedial measures to protect the environment. To facilitate the protection of the environment by the people of Canada. To establish levels of environmental quality. To inform the people of Canada on the state of the environment. To endeavour to protect the environment from the release of toxic substances.	Establish and operate environmental monitoring programs. Formulate objectives, guidelines and Codes of Practice.
FISHERIES ACT	FISHERIES AND OCEANS CANADA ENVIRONMENT CANADA ONTARIO MINISTRY OF NATURAL RESOURCES	To protect fish, shellfish, crustaceans and marine animals in all waters in the fishing zones of Canada and all internal waters of Canada.	Minister may require owners of obstructions in waterways to provide channels for fish to pass. No person shall deposit deleterious substances in water frequented by fish.
NAVIGABLE WATER PROTECTION ACT	TRANSPORT CANADA	No work may be undertaken affecting navigable waters unless approved by the Minister.	The Act stipulates that no person shall deposit any material or rubbish into navigable water that is liable to interfere with navigation.

TABLE 2.

ENVIRONMENTAL LEGISLATION

	AGENCY	OBJECTIVE	IMPACT
PROVINCIAL			
BEACH PROTECTION ACT	ONTARIO MINISTRY OF NATURAL RESOURCES	To ensure that, if material is to be removed from beach area, the operation does not cause undue erosion or impair water and fish habitat.	Stipulates a licence requirement for taking sand.
CONSERVATION AUTHORITY ACT	ONTARIO MINISTRY OF NATURAL RESOURCES; LOCAL CONSERVATION AUTHORITIES	To establish programs to conserve, restore, develop and manage watersheds.	May purchase, lease or expropriate land, control surface water flow and alter water courses. May have the power to regulate the construction of works, placing of fills, etc. in defined areas.
DRAINAGE ACT	ONTARIO MINISTRY OF AGRICULTURE AND FOOD	The Drainage Act is directed primarily at works which affect two or more parties and are constructed on agricultural land.	Drainage works include drain construction as well as improvements to natural water courses. Drainage works also include the works necessary to regulate the level of water in a drain, reservoir, lake or pond, such as a dam, well, protective works or any combination thereof.
ENVIRONMENTAL ASSESSMENT ACT	ONTARIO MINISTRY OF THE ENVIRONMENT	Ministerial approval of the Environmental Assessment document is required before the project will be approved, and before consent by any regulatory authority.	The Act currently applies to projects undertaken by the Provincial Government and municipalities. At this time the Act does not generally apply to the private sector.
ENVIRONMENTAL PROTECTION ACT	ONTARIO MINISTRY OF THE ENVIRONMENT	To provide for the protection and conservation of the natural environment. Prohibits the discharge of contaminants that are likely to have and adverse effect on the natural environment.	The Act prohibits the discharge of any contaminant into the environment in an amount exceeding that prescribed by regulation or at a level which is likely to cause the impairment of the natural environment. Certificates of Approval must be obtained from the Director for the management of waste, the deposit of waste and discharges to the natural environment. Many regulations have been issued under this Act dealing with air, water and waste management concerns.

TABLE 2.

ENVIRONMENTAL LEGISLATION

ACT	AGENCY	OBJECTIVE	IMPACT
		PROVINCIAL	
LAKES AND RIVERS IMPROVEMENT ACT	ONTARIO MINISTRY OF NATURAL RESOURCES	To purpose of the Act is to provide for the use of lakes and rivers in Ontario and to regulate improvements in them.	Approval is required for the construction and alteration of dams. The Act prohibits the deposit of matter into lakes and rivers. The Act may be applied to any drain that uses a natural stream as a part or the whole of its length and is applicable to any drain that outlets into a natural stream or lake.
ONTARIO WATER RESOURCES ACT	ONTARIO MINISTRY OF ENVIRONMENT	This is the main legislative basis for water management in Ontario. The Act prohibits the discharge of any material that may impair the quality of any well, lake, river, spring, stream or other watercourse.	Requires approval by the Director for any construction or altering of water and sewage works. Regulations for the taking of water and construction as well. Under the Act, the definition of sewage would include both the drainage water from agricultural lands and the sewage from an individual rural residence.
FARM PRACTICES PROTECTION ACT	ONTARIO MINISTRY OF AGRICULTURE AND FOOD	This Act establishes the Farm Practices Protection Board. The Board deals with odour, noise and dust problems and has the power, on request of an aggrieved person, to inquire into and resolve a dispute respecting an agricultural operation. This includes the determination as to what constitutes a normal farm practice. The Board also has the power to make inquiries and orders as are necessary to ensure that there is compliance with its decisions.	Any person who carries on an agricultural operation that does not violate land use control laws, the Environmental Protection Act, Pesticides Act, Health Protection and Promotion Act, or the Ontario Water Resources Act is not liable in nuisance to any person for any odour, noise or dust from the agricultural operation as a result of normal farming operations.
PESTICIDES ACT	ONTARIO MINISTRY OF THE ENVIRONMENT	The purpose of this Act is to ensure the safe use and management of pesticides. This Acts relates to agricultural pollution control.	No person shall deposit, add, emit or discharge a pesticide into the environment that causes or is likely to cause impairment, injury or damage to the quality of the environment greater than the occurrence that would necessarily result from the proper use of the pesticide.

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CONSERVATION PLANNING AND THE GREEN PLAN

by
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INTRODUCTION

Thank you Mr. Chairman. My topic today is 'CONSERVATION PLANNING AND THE GREEN PLAN'. First I would like to discuss the situation we find ourselves in on the rural prairies. Then I will make some comments on how planning for implementation of the Green Plan may be affected by this situation.

OUR RURAL SITUATION

All is not well on the Canadian prairies. Rural people are deeply concerned about their situation. They are concerned about cash availability on farms, market instabilities, depopulation of rural communities, and environmental degradation. To survive these challenges to our land, economy and social fabric will require vision and commitment.

FINANCES

Rural people are concerned about their financial situation. Cash availability, which has been a problem for prairie farmers throughout most of the 80's has now reached a new and dangerous low point. Most farmers are concerned that the situation will not improve dramatically in the near future. Governments have responded with financial support. In addition, many farmers have opted for off farm jobs to create some financial stability. Off farm employment is seen as both a short term and longer term solution to income stability. Many farm people are professionals who seek further professional development through off farm employment, some see off farm employment as a way of stabilizing the rural exodus, while others see it as a necessary short term activity to prevent bankruptcy.

MARKET INSTABILITY

Rural people are concerned about market instability. The people of the rural Canadian prairies rely heavily on the production and export of grains and oilseeds for their welfare. The physical, economic and social infrastructure on the prairies has been developed on this basis. World markets for grains and oilseeds are characteristically unstable. Markets vary with at least four important factors. These include world consumption, which depends on customer purchasing capability; production capability, which changes with the production techniques and world weather; government self sufficiency and rural stability policies; and government export support policies.

The instability of world markets will likely continue because of these factors. It is hoped that the dramatic effects of export subsidies can be moderated significantly through a new GATT agreement. However, one can only conclude that the instability of world grains and oilseeds markets, that we have observed in the past, will continue into the future.

Exports of grains and oilseeds have been of great benefit to all Canadians in the past. Because of these benefits governments have instituted programs aimed at buffering farmers from market and weather-based instabilities. Programs are also in place that are aimed at increasing production efficiencies. Support is based on the philosophy of self reliance and tempered by the ability of governments to provide support. This market instability is not new. There have been many calls in the past to diversify farm production. These have not been very successful on most of the prairies for a variety of reasons.

SOCIAL STRUCTURES

Rural people are concerned about the disintegration of their social structures. Schools, hospitals, churches continue to close. In the heart of the prairies full rural service centres are disappearing at an alarming rate. Depopulation of rural areas has taken place over the years primarily as a result of changes to road transportation, the mechanization of farms, and the natural consolidation of land as land is traded. It is now common for farm youth to choose another way of life. Intergenerational transfer of land and assets is now less likely. As a result the dominant trend towards land consolidation is enforced. Many elements of a stable rural society are now at risk. People of the prairies have become more concerned over their way of life. This situation may be worsened by low commodity prices although some analysts suggest that higher commodity prices would lead to further depopulation of the prairies as older farmers sell and move away. The short term financial problems may be diverting our attention from this long term adjustment. Many analysts have concluded that rural communities must now depend on other economic drivers as well as primary agriculture if they are to survive.

Farmers depend on rural communities. As services are no longer available locally, farmers must spend more time and resources travelling to larger centres for farm and business services. Also, farmers must travel increasing distances for social services such as schools, churches and medical facilities. Farmers also depend on rural communities for off farm income and for employment opportunities for their children.

THE ENVIRONMENT

Rural people are also concerned about degradation of their environment. Our land is less fertile than when it was first broken. It is becoming clear that, in some cases, agriculture has negatively affected the resources it uses or impacts. Significant areas of low quality and highly erodibly land are annually cultivated. As well as affecting soil resources, agriculture practices can affect water quality, as well as the flora and the fauna. Considerable efforts are underway through soil conservation, and other environmental sustainability initiatives to understand and neutralize the negative environmental impacts, and to enhance environmental assets.

HOW DO WE LOOK AT PRAIRIE SUSTAINABILITY - THE LAND AND THE PEOPLE

Rural prairie people have accomplished a great deal while developing their economic base and social structures. The food and fibre we produce for domestic and external markets rival that of any culture that has ever existed on this planet. We have specialized production and transportation systems, sophisticated marketing procedures and reliable quality control methods. Meanwhile, our education and communication systems are constantly refined and upgraded. We have an excellent base from which to address these rural issues.

Sustainable agriculture will likely involve diversification both on and off farm, as well as dealing with the instability of grains and oilseeds markets. However, the agriculture issue cannot be properly addressed without also considering the other issues, primarily rural social issues and environmental issues characterized by depopulation and environmental degradation. Rural employment is required in order to attract people that provide the base demand for social services which are, in turn, required to maintain a stable agriculture sector in rural areas. Farms are an attractive source of employees for rural endevours. In turn, off farm employment can be an essential source of funds required to stabilize farm income and to fulfil the career ambitions of members of the farm family. We also know that we have a very attractive natural environment. We are rightly dedicated to protecting it. Have we been dedicated enough to finding sources of rural employment based on our natural environment?

HOW TO ADDRESS THE RURAL ISSUE

The rural issue is being discussed as never before on the prairies. Through this discussion the issue will be further defined and directions developed. In my opinion Prairie Sustainability will require sustainability of the land and the environment, sustainability of the community and its social structures, and sustainability of the rural economy with the rural economy increasingly involving other economic drivers as well as primary agriculture. It will require sustainability of all three together. The people of the prairies will not achieve rural sustainability if we address only one of these issues and not the others. We should look for integrated solutions that involve an overall concept of rural sustainability - integrated solutions that provide employment opportunities, stable markets, and environmetally friendly production processes. The challenge before prairie people is considerable.

So where am I with regard to the primary topic:

HOW SHOULD THIS RURAL SITUATION AFFECT HOW THE GREEN PLAN IS IMPLEMENTED?

A little history is probably in order. When Agriculture Ministers, federal and provincial, undertook the Agriculture Policy review they agreed to four 'pillars' - Market Responsiveness, Self Reliance, Regional Sensitivity and Environmental Sustainability. A federal-provincial task force studied environmental sustainability and came up with recommendations which were accepted by Agriculture Ministers. When the Green Plan action plan was being developed it was agreed that the recommendations accepted by Agriculture Ministers would be the basis for implementation of the agriculture part of the Green Plan. On this basis consultations were carried out in Alberta where the general recommendations were targeted to the Alberta situation. The results of these consultations will be used in the negotiations of a federal provincial agreement.

I feel quite strongly that we should actively seek environmental solutions that are supportive of actions that address the prairie rural situation as a whole. Are there ways to do this?

EMPLOYMENT

Stable employment in rural areas is critical for the survival of communities upon which farmers depend. It is also likely that, for many communities, employment based on other sectors than primary agriculture is necessary. Many endevours could be based on the advantages offered by the natural environment. These endevours may be complementary to agriculture activities. They may involve tourism for example. In considering environmental sustainability activities it may be possible to do things in a way that enhances the chances of other employment generating activities.

Also, it may be possible to carry out environmental sustainablity activities that enhance rural employment directly.

INFORMATION

How do we get the best information in the hands of farmers, analysts, and program managers? We know that the glaciers left the moraines, lake beds, beaches and outflow channels that are the basis of the landscapes, and consequently the agriculture capability and environment we have on the prairies today. We must also utilize regional planning data bases effectively. We have the computer technology that allows these data to come together - landscape and other regional planning data. This information could then be targeted in the development of various concepts, whether they be for rural employment generation, diversifying agriculture, environmental sustainability of agriculture, or an integrated concept. This capability may not be critical to farmers who understand their local environment very well. It could, however, be very important to analysts and people supplying information. It could also allow for the more effective formulation of integrated solutions and better communication between farmers and others.

CONCLUSIONS

We can and should be holistic in our approach to sustainability. If you will permit me to repeat myself, Prairie Sustainability will require sustainability of the land and the environment; sustainability of the community and its social structures; and sustainability of the rural economy, with the rural economy increasingly involving other economic drivers as well as primary agriculture. It will require sustainabiliy of all three together. The people of the prairies will not achieve rural sustainability if we address only one of these issues and not the others. If we look for integrated approaches to the rural prairie issue I believe we are also more likely to find long term environmental sustainability solutions.

Implementation of the agriculture element of the Green Plan should be addressed in this context. We must aim our activities at agriculture environmental sustainability but we should do this in such a way that enhances rural sustainability as a whole.

EVALUATING ALTERNATIVE AGRICULTURAL LAND MANAGEMENT POLICIES FROM A WATER QUALITY PERSPECTIVE:

An Automated Land Information Systems Approach

by
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ABSTRACT

The integration of geographic and land information system (GIS/LIS) techniques and computer modelling is increasingly used to support rural resource management and policy analysis. GIS/LIS data handling capabilities can enhance tabular models by incorporating dimensions of space and time. Spatial analyses can augment the understanding of relationships between land-use and environmental quality. They have been particularly helpful in implementing and assessing the impact of mandates such as the 1985 Food Security Act (FSA) and 1990 Food, Agriculture, Conservation, and Trade Act (FACTA). These mandates link environmental quality standards to agricultural practices and U.S. Department of Agriculture (USDA) commodity program benefits. This paper presents the results of a study designed to evaluate the contribution of conservation treatment and agricultural forests in maintaining environmental quality. The study was conducted in the Garfoot Creek drainage area of the Black Earth Creek Watershed (Dane County, Wisconsin).

The study explored the usefulness of a creating a multipurpose LIS and linking it to a water quality assessment model for evaluating existing and pending land management policies. In order to develop the model land management scenarios used in these evaluations, numerous natural resource layers and land management practices were integrated into a digital database. A land cover data layer was developed using experimental orthophotography. Forest cover was analyzed to determine its spatial and temporal distributions. Information about agricultural practices at the farm field level was obtained from the Dane County Land Conservation Department's (DCLCD) farm cooperator database. These data, combined with information on soils, slope, hydrology and landcover, were used as input to the Wisconsin Nonpoint Source Pollution Model (WIN). The model, used by the Wisconsin Department of Natural Resources (DNR), estimates soil erosion at the individual farm field level and calculates sediment delivery based on surface water flow between individual farm fields. Agricultural use scenarios were developed, modeled, and evaluated to determine the environmental outcomes associated with each scenario. Reductions in agricultural nonpoint pollution due to changes in forest cover extent versus agricultural conservation treatment were compared.

SYNOPSIS OF RESULTS

The results of our investigations indicate that traditional conservation treatment practices can significantly reduce soil erosion and sediment delivery rates on highly erodible lands. However, the introduction of forest uses provides even more significant reductions when it replaces highly erosive agricultural practices. Also, if all highly erodible cropped fields (where actual soil loss exceeds tolerable rates) are brought within tolerable limits using conservation practices, reductions in soil erosion and sediment delivery would be comparable to changing cropped use to forest use. The study also found that despite more acreage in crop production, sediment delivery rates and loadings to receiving bodies in the 1930s were similar in magnitude to current conditions with conservation treatment. This appears to be primarily due to the less intensive crop rotations used in the early part of the century.

The study suggests that the WIN model is a more reliable and valid measure of water quality impact than the Universal Soil Loss Equation (USLE), since it allows policymakers to estimate sediment delivery to receiving waters. GIS/LIS data manipulation and analysis can greatly facilitate the evaluation of land management options using quasi-spatial water quality models such as WIN because it allows the rapid evaluation and display of alternatives.

INTRODUCTION

Until recently, policies that influenced rural land use encouraged traditional agricultural production and timbering, even on sites where the soil type and slope made practices detrimental to the environment. Despite active conservation movements, little or no policy addressed concerns such as watershed protection, biological diversity, and wildlife and fish habitat. Since the 1970's, there has been growing interest in identifying the external impacts of resource exploitation by better understanding physical landscape processes and interactions. This knowledge can provide the foundation for policies that require rural landowners to manage their land not only to meet production and economic goals, but to also protect environmental quality. The research goals of this study were to evaluate the usefulness of GIS/LIS technology to help quantify the benefits of sound rural resource management as called for in the conservation provisions of the 1985 FSA and 1990 FACTA; establish a sound basis for evaluating long-term tradeoffs in various land management options; and to evaluate policies that advocate the investment of public funds in rural resource management. GIS/LIS techniques combined with agricultural nonpoint pollution models can provide a means with which to analyze the impact of existing land uses and compare them to alternative land use management scenarios. These predictive analyses offer resource planners and policy makers hard data to evaluate the impact of resource policy and build an awareness among rural landowners of their influence on environmental quality.

During this study, special emphasis was given to the role of agricultural forests in environmental quality. In addition to providing commercial products, scenic beauty and visual contrast in a landscape, agricultural forests offer habitat to wildlife and deter soil erosion and sediment delivery, thereby protecting surface water quality and associated fisheries. This study used water quality for brown trout as a measure of environmental quality, since Garfoot Creek, the study area, is tributary to Black Earth Creek - known for its high quality trout fishery. The relative water quality benefits under agricultural production or forest cover were compared by examining this measure. Research showed how these different land uses could complement one another and also quantified their relative contributions to the selected measure of environmental quality.

In order to best serve decision-making by resource planners, managers and policy makers, it is essential to provide information that relates sediment delivery to individual agricultural operators and their unit of management (i.e. farm field).

Water quality was predicted based on the model-estimated amount of sediment delivered from cropped farm fields to surface waters. The WIN model is designed to use a database that includes information at the farm field level and associates each field with a farm operator. Output from the model identifies critical upland areas contributing sediment to receiving waters, which permits more effective targeting of soil erosion and runoff controls. Running the model under various land management scenarios provides resource planners and policy makers with a flexible tool for deciding how to achieve environmental quality goals while still meeting the production needs of agricultural operators.

STUDY AREA

Research was conducted in the Garfoot Creek subwatershed in the township of Cross Plains (Dane County, Wisconsin), located within the Black Earth Creek Watershed. The drainage, encompassing approximately six square miles, is a complex mixture of glacial river terraces, steep side slopes, and flat ridges. The original landscape was composed of mostly prairie, wetlands and forests. It is now intensively farmed on terraces and ridges while slopes are mostly second-growth mixed deciduous forests.

METHODS

DATABASE DEVELOPMENT

Establishment of a multipurpose LIS for this project required automation of many natural and cultural features as individual data coverages. Database development began during earlier research, including evaluation of wildlife habitat suitability as a measure of environmental quality. A descriptive model was developed using GIS/LIS to simulate expert knowledge on habitat appropriate for the re-introduction of wild turkeys (Serra et al., 1990). Additional coverages required for the water quality study included reclassified landcover, farm field and tract boundaries, hydrology, and associated attribute data describing vegetation type and agricultural management practices. A summary of data sources and processes used to create final project coverages is shown in Table 1.

Farm Field and Tract (Ownership) Boundaries

Farm field and tract boundaries, based on rectified aerial photos maintained by the USDA Agricultural Stabilization and Conservation Service (ASCS), were digitized using pc ARC/INFO. These boundaries are used by both ASCS and DCLCD personnel to meet their respective federal and state mandated program planning and compliance monitoring requirements. Farm fields served as the unit of analysis for the WIN model and provided the link to crop management attributes maintained in the tabular DCLCD database, and other landscape characteristics (e.g. soils, slope). Landowners enrolled in any DNR forestry programs were identified by reviewing DNR files. Enrollment in a program was included as an attribute in the database and served as a measure of future land use intent.

TABLE 1: DATA SOURCES AND PROCESSES USED TO CREATE COVERAGES

Coverage	Data Source	Automation Process
Sections	USGS 1:24,000 DLGs	Digitized
Townships	USGS 1:24,000 DLGs	Digitized and dissolved on Sections
Roads	USGS 1:24,000 7.5' Quadrangle Sheets	Digitized
Soils	SCS 1:15,840 Soil Survey	Soil sheets digitally scanned
Slopes (TIN)	USGS 1:12,000 3.75' DEM Quadrangle Sheets	Digitized elevations into point file. TIN software created polygon coverage.
Streams	USGS 1:24,000 7.5' Quadrangle Sheets	Digitized
Wetlands	WDNR 1:24,000 Digital Database	Digited and converted to GIS format
Farm Fields & Tracts	ASCS 1:12,000 Unrectified Aerial Photography	Digitized field & tract boundaries. ASCII file transfer of attribute data into digital coverage
Landcover	1. 1:7,920 1832 Finley Vegetation Maps 2. 1:7,920 1931 Land use economic inventory map 3. USGS 1:12,000 3.75' Orthophoto Quadrangle Sheets	1. Digitized 2. Digitized 3. Manual interpretation and entry into field and Tract Coverage.

Field Management

The DCLCD 's tabular database contained detailed information about farming practices at the farm field level. Information is stored on a farm field basis and is linked to ownership by unique identifiers assigned to each farm operator. Pertinent crop management information was exported from the database as an ASCII file and then linked to the study area field coverage based on the unique field identifier. Technically this is a simple process, however constant changes in tract and field identifiers by ASCS resulted in incomplete or old information being obtained from the DCLCD database. Therefore, one had to constantly cross-reference mapped field and tract identifiers with ASCS changes and DCLCD database updates. For a small area such as Garfoot Creek subwatershed, it was just as easy to write field attributes to hard copy (printout) and manually code them into the field coverage. The type of attributes linked to the field coverage included crop type, planting rotation, plowing practices, and the tolerable soil loss assigned to each field based upon predominant soil characteristics.

Soils

The Dane County soil survey was automated prior to this study as part of a larger research project - the Dane County Land Records Project. Digital soil boundaries for the study area were clipped from a larger coverage and then overlayn with the farm tract and field coverage. This resulted in several soil types per field. Since WIN requires only one soil type designation per field, the predominant one based on area was determined. Additional soil characteristics transferred to each field in the field coverage through the overlay included percent slope, soil erodibility (K), and a SCS defined slope-length parameter (LS). Soil characteristics available in the DCLCD database superceded those determined through the overlay because they were based on site field investigations of farmers participating in conservation programs.

Landcover

Landcover was originally developed to support the wildlife habitat investigation. A vegetation map from 1832 (Finley, 1951), a 1931 land use inventory map drafted during an economic land inventory (Kaufer, 1976), and 1987 landcover interpreted from the 1:12,000 orthophotographs were automated. The three maps were digitized and transformed into a local Transverse Mercator projection. For standardization purposes, the landcover categories were aggregated to represent the simplest of the three classification schemes; the Finley map. Landcover categories consisted of forest, wetland, and cropland. Oak opening and prairie cover were independently digitized based on more detailed survey notes written by Finley that were not included in his final map. In the 1931 and 1987 coverages, the category of abandoned field/pasture was added to illustrate spatial land use changes. The 1987 forest cover was further classified by interpretation of the 1:12,000 orthophotos to reflect the forest types represented in the WDNR forestry programs, ('Woodland Tax', 'Managed Forest Law', and 'Forest Cropland'). The general forest category was expanded into either mixed oak, red cedar or pine.

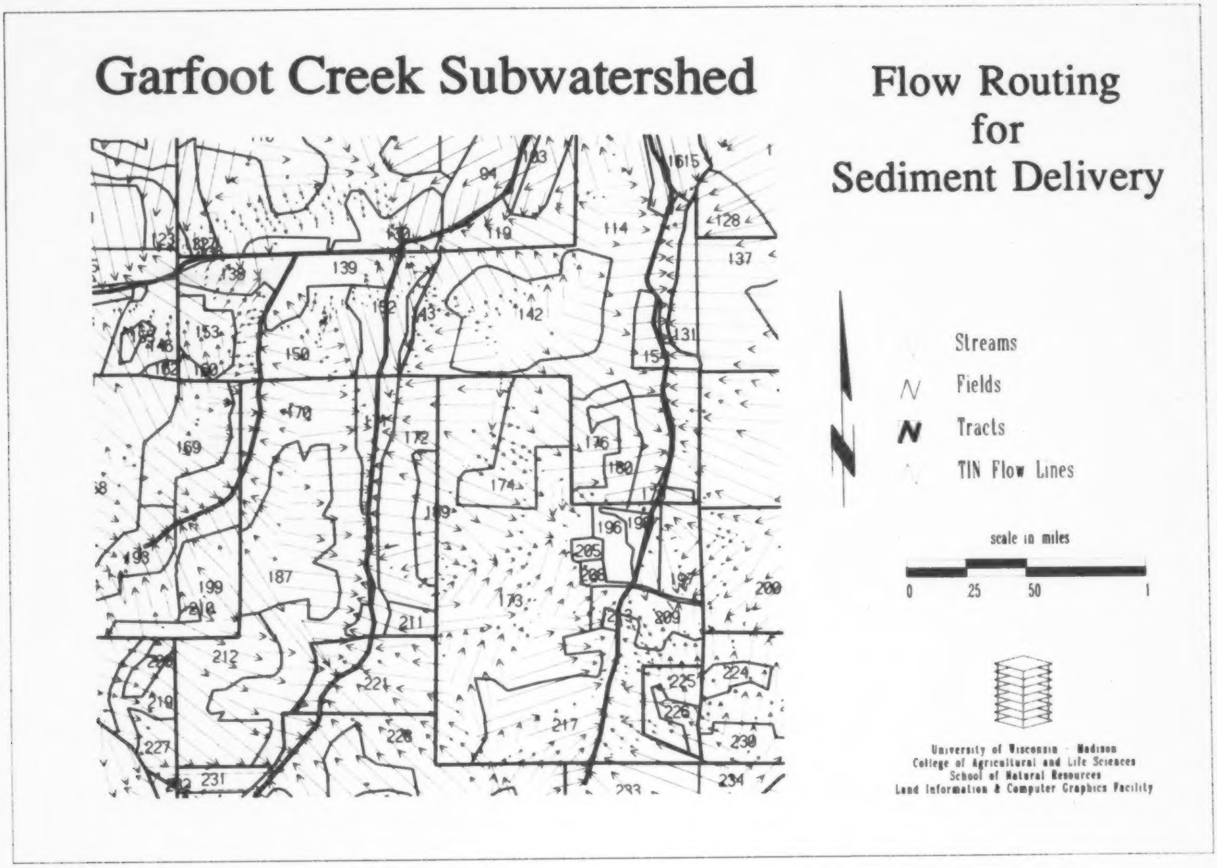
Temporal changes in landcover were measured to assess spatial distribution of suitable wildlife habitat and predict its distribution in the future. Analyses revealed that forest cover shifted from 56% coverage in 1832 to 29% in 1931 and to 49% in 1987. Another ongoing phase of research (Heinzel, 1991), is using automated methods to analyze patch sizes, corridors, forest edges, and edge to area ratios to further understand the implications of changes in land use and their impacts on ecological resources.

Specific needs of the WIN model required reclassification of this landcover to include additional cover categories such as urban, shrub, grassland, and pasture. Landcover was modified by manual interpretation of the 1:12,000 orthophotos. A mylar plot depicting the subwatershed boundaries, roads, streams, and field and tract boundaries at 1:12,000 was overlaid on the orthophotos. Landcover types were classified, delineated on the plot and then added as features to the landcover coverage. For the 1931 agricultural management scenario, that years' economic inventory was used.

Flow Routing

Sediment delivery calculations performed by the WIN model require surface water flow information. This information takes the form of user defined flow linkages between individual farm field polygons. Since water flows from a field into either another field or water body, the terminology used to describe this attribute is "outcell". The outcell and flow length across the field are included in the field and tract coverage.

Figure 1


Garfoot Creek Subwatershed
Flow Routing for Sediment Delivery
Streams
Fields
Tracts
TIN Flow Lines
scale in miles
0
25
50
1
University of Wisconsin - Madison
College of Agricultural and Life Sciences
School of Natural Resources
Land Information & Computer Graphics Facility

Previous research for the study area had produced a digital point coverage in ARC/INFO format containing elevation values derived from USGS 3.25" quadrangle contours. These points were used create a triangulated irregular network (TIN), defining terrain slope and aspect characteristics. Fortran algorithm were developed and used to generate a separate coverage of lines based upon the aspect of each triangle in the TIN. The lines ran parallel to the aspect of each triangle, and when graphically displayed, depicted the surface water flow direction across an area. To relate this flow routing information to study area farm fields, a graphic overlay of the field and tract coverage, aspect lines coverage, and stream coverage was created. The depiction of flow vectors facilitated interpretation of field flow linkages (Figure 1).

Flow linkages were assigned to each field through visual examination of the field/aspect line graphic and database coding. Direction of flow was estimated by judging the direction of the majority of the flow lines on a field. Large fields that exhibited complex topography required subdivision according to smaller topographical units. In this case a common farm field identifier was maintained for each subfield. A separate Fortran algorithm was written to try and automate the interpretation process, however, the program was still not sufficiently tested and verified at the time of project documentation. Programming obstacles encountered are attributable to the fact that little previous work has been done to handle surface water flow routing in a vector rather than a raster (grid cell) environment.

ESTIMATING SEDIMENT DELIVERY USING THE WIN MODEL

Model Operation & Inputs

The WIN model estimates rates of sediment delivery from rural lands to surface waters. Streams can be divided into segments requiring special study. Sediment delivery can be estimated for single or multiple rainfall events. Rates are linked from receiving bodies back to individual fields and to ownership through farm field and tract attributes in the database. Potential farm field soil loss due to sheet and rill erosion are calculated by the model using an adaptation of the SCS Universal Soil Loss Equation (USLE). The variables required by USLE are listed in Table 3. The USLE has traditionally been used by resource managers as a sole indicator of agricultural environmental quality. In order to use this tool as a measure of water quality, a number of assumptions have to be made about how much sediment will actually leave the field, its rate, flow path, and eventual destination. WIN is able to estimate sediment delivery rates and receiving water impacts by taking into consideration many more landscape variables then the USLE.

TABLE 3: THE UNIVERSAL SOIL LOSS EQUATION (USLE)

$$A = R * K * LS * C * P$$

A	Predicted average annual soil loss in tons/acre/year
R	Rainfall factor
K	Soil erodibility factor
LS	Slope-length and slope-gradient factor
C	Cropping management factor
P	Erosion control practice factor

WIN input requirements include information about soils, agricultural practices, landcover types, hydrology, topography, seasonal rainfall, and climatic factors effecting evapotranspiration rates. For our study area, rainfall and evapotranspiration data were available from the Wisconsin DNR. Other data were extracted from the coverages described earlier. Table 5 lists input parameters to the model, their data source, and a brief description of each parameter. Figure 2 provides a schematic summary of the WIN database compilation process. Not all field attribute data compiled for this study were required input of the WIN model. Some attributes were included for creating maps and enhancing interpretation of the land use scenarios.

A number of pcARC/INFO macros were written to extract the field attributes required by the model and sort them in proper input order. An intermediate ASCII file was used to transfer the data from pcARC/INFO to the Rbase database management program. WIN uses the Rbase format for internal data manipulations.

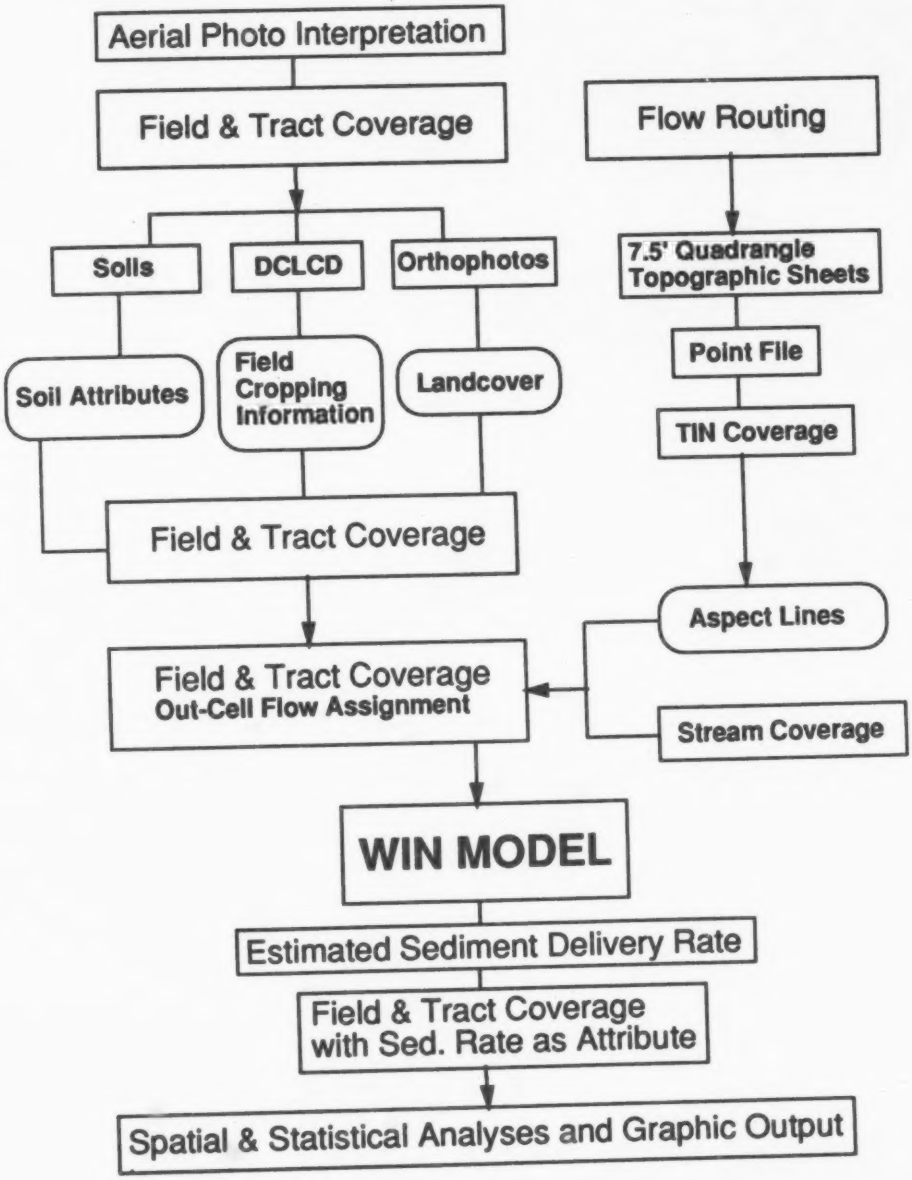
In addition to field data, separate Rbase files were created to serve as lookup tables for the model to cross-reference crop rotations, soil attributes, watershed statistics, etc. Model runs for the study area took less than thirty seconds for each scenario, though data debugging usually added another hour or two to each scenario run. Model output included estimates of sediment delivery for each farm field and for non-cropped fields such as pasture and forest. WIN has default values for non-cropped uses. Model output also included total subwatershed sediment production for individual storm events in an average year. Rainfall duration, depth, and frequencies were statistically generated using DNR guidelines. Farm field sediment delivery results were linked back to the field coverage for graphic display and interpretation.

Land Use Scenarios

The model can be used interactively by resource managers to evaluate alternative land management practice scenarios and the impacts of various conservation treatment options. For example, a county resource manager may want to estimate the quantity and cost of practices needed to reduce in-stream sediment loads to target levels, as well as the time needed to design, install and certify these practices. If model results for a particular land management scenario are unacceptable (i.e. they do not meet established standards or policy), the land management plan can be quickly modified and the model run again to evaluate the effects of these changes.

Figure 2

Database Compilation Process for the WIN Model


Aerial Photo Interpretation
Field & Tract Coverage
Flow Routing
Soils
DCLCD
Orthophotos
7.5' Quadrangle Topographic Sheets
Point File
Soil Attributes
Field Cropping Information
Landcover
TIN Coverage
Field & Tract Coverage
Aspect Lines
Field & Tract Coverage
Out-Cell Flow Assignment
Stream Coverage
WIN MODEL
Estimated Sediment Delivery Rate
Field & Tract Coverage with Sed. Rate as Attribute
Spatial & Statistical Analyses and Graphic Output

Alternatively, policy makers may wish to modify policy if required practices place excessive management or economic burdens on farm operators/owners. The effect of policy changes can also be quantified using WIN.

TABLE 5: DESCRIPTION AND SOURCE OF DATA INPUT TO WIN MODEL

INPUT PARAMETER	DATA SOURCE	DESCRIPTION
Soil Code Soil Symbol Slope % K,LS,C,P,R	Soil Conservation Service	-Soil Code # -Soil Type -Percent grade of soil -Parameters used in USLE pertaining to soil texture, slope, plowing and cropping mngmt., and avg. rainfall
Farm Operator Tract # Field # Crop Rotation Rotation Code Plow Practice Mgmt. Code T - Factor	Dane County Land Conservation Dept.	-Names and ID's used in the Dane County Cooperator TrackSystem -Crop and planting pattern -Code for crop rotation -Up-and-down, contour, strip -Conservtn. tillage practices -Tolerable soil loss
Landcover	USGS Orthophoto 3.75' Quadrangle Sheets	-Landcover types identified from orthophotos (Cropped fields, Pasture, grassland, forest, wetland, residential)
Flowlength Celltype Cellout	Fortran Flow-routing algorithm using: 1. Field & Tract, 2. Stream, and 3. TIN coverages	-Length of Field that sediment is likely to flow -Whether the cell of concern is a field or a stream -Whether the receiving cell is a field or a stream
Watershed Code Subwatershed Code	Wisconsin Dept. of Natural Resources	-Code assigned to watershed -Code assigned to sub-watershed
Township Code In-cell township Out-cell township	Township Coverage from USGS 1:24,000 DLGs	-Code assigned to township twice, once for in-cell once for out-cell
Section Code In-cell section Out-cell section	Section Coverage from USGS 1:24,000 DLGs	-Code assigned to PLSS section once for in-cell once for out-cell
USLE Area Parcel ID	Calculated in Database	-USLE = K * LS * C* R * P -Area of parcels in Acres -Unique Identifier #

The Garfoot Creek subwatershed farm tract and field coverage was manipulated to represent five different agricultural land use scenarios. They reflected different acreages of forest and cropland in the subwatershed as well as various agricultural practices.

Agricultural Use Scenario 1: This scenario portrayed existing land use with in-place agricultural conservation practices. The scenario provides a reference point for comparison with other land use scenarios.

Land Use Scenario 2: This scenario reflects existing agricultural use with none of the soil conservation provisions mandated by the 1985 FSA and 1990 FACTA. Comparison with Scenario 1 quantifies the impact of these soil erosion conservation provisions.

Land Use Scenario 3: This alternative depicts the contemporary rural landscape if cropped land were allowed to revert to forest where actual soil loss (A) is greater than the tolerable soil loss (T). Comparison with Scenarios 1 and 2 illustrates the impact of utilizing agricultural forest to prevent soil erosion and sediment delivery, relative to the implementation of agricultural conservation practices.

Land use Scenario 4: This alternative describes the contemporary rural landscape where cropped land with agricultural practices that experience actual soil loss exceeding tolerable conditions ($A > T$) are amended to yield $A = T$. Amendments are in the form of standard conservation treatment instead of conversion to forest use. Comparison with Scenario 1 measures the effectiveness of additional conservation practices. Comparison with Scenario 3 highlights the difference between forest cover and conservation treatment for controlling soil erosion and sediment delivery.

Land use Scenario 5: This scenario recreates the rural landscape as it appeared in 1931, using the landcover and agricultural practices typical of that period, but assuming current field and tract delineations. The purpose was to depict a situation similar to the Hubbard Brook Study (Bormann, et al, 1974; Likens et al, 1977) where an entire subwatershed was deforested to measure the amount and rate of soil erosion. This study uses computer and GIS techniques to conduct a similar experiment, though complete deforestation is not assumed. The 1931 economic land inventory map was chosen as a more realistic alternative; 1931 being a time where forest cover acreage in Southern Wisconsin was near its lowest since European settlement.

The decision to use current field and tract boundaries for the 1931 landcover was made to provide clear graphic output for visual comparison. The 1931 landcover distribution was assigned to the current field and tract delineations by a majority-based rule. Whichever landcover category comprised the greatest acreage was assigned to the field. Such classification does alter the true landcover distribution for that time period; it does not accurately reflect surface water flow conditions. Subsequently, estimated sediment delivery rates must be evaluated in light of this fact. Given the research purposes of this study, however, the 1931 depiction provided a sufficiently realistic depiction of how land use, agricultural practices, and therefore sediment delivery rates to surface waters were different.

RESULTS

Tables 6 and 7 contain the results of spatial and statistical analyses of the WIN output for the five agricultural land use scenarios. Comparing the columns depicting percent of total watershed acreage for the two scenarios illustrates how the acreage without conservation practices suffers a significant increase in sediment delivery. With conservation practices in place, the status quo in Dane County, 94.5 % of the watershed acreage generates less than 1 ton/acre/year of sediment. In contrast, scenario 2 results in more than half the watershed producing sediment at greater than 1 ton/acre/year. These results indicate that agricultural conservation practices can have dramatic impact on sediment delivery from cropped fields and are valid tools for improving environmental quality. These results also quantitatively document the benefits derived from the conservation provisions of the 1985 FSA and 1990 FACTA.

TABLE 6: SEDIMENT DELIVERY RATES IN GARFOOT CREEK SUBWATERSHED FOR TWO LAND-USE SCENARIOS

	Current Land-use and Conservation Measures		**Current Land-use -- No Conservation Measures**	
Sediment Delivery Rate in Tons/Acre/yr.	# of Fields	% of Total Watershed Acreage	# of Fields	% of Total Watershed Acreage
<1	222	94.5	109	45.0
1-3	6	2.5	26	9.5
3-10	1	0.7	56	26.5
>10	2	2.3	40	19.0
Totals:	231	100	231	100

Table 7 compares data for all five scenarios aggregated at the subwatershed level. Both soil loss (USLE results) and sediment delivery results are expressed in tons/year. Contributing cropped acreage has been factored into the summaries. Also, these results only reflect total sediment delivery from cropped fields, excluding non-cropped lands; though there can actually be some sediment from other land covers, it is minimal compared to that from agricultural land. Figure 3 illustrates the relative sediment contribution of all land cover types for scenario 1. One can see that cropped fields produce the majority of sediment. Figure 4 offers a spatial dimension to the WIN results for the first two scenarios.

Scenario 1, the current land use with agricultural conservation measures was used as a point of reference to compare scenarios 2 through 5. Implementation of conservation treatment due to federal programs results in a more than three-fold reduction in soil loss and sediment delivery. However, comparison of scenario 2 and 4 illustrates that much more could be achieved in pollutant reduction if all highly erodible cropped fields (A>T) were brought within tolerable limits.

Figure 3

Sediment Delivery by Land Cover: Existing Conditions (S1)

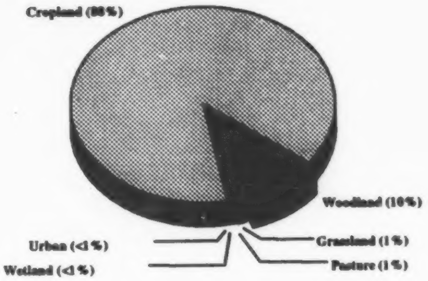
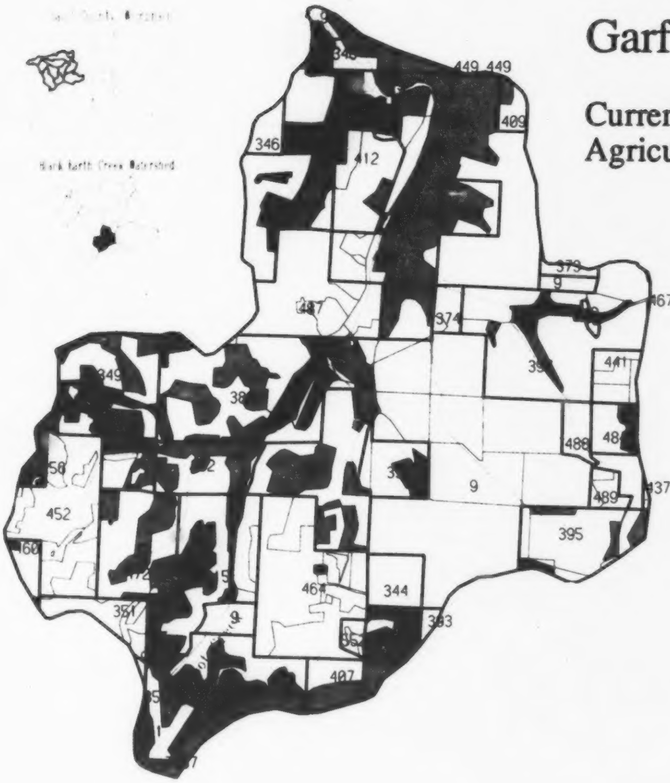


TABLE 7: ESTIMATED SOIL LOSS AND SEDIMENT DELIVERY FOR AGRICULTURAL LANDUSE SCENARIOS IN GARFOOT CREEK SUBWATERSHED

Land-use Scenarios	Agricultural Acres		Total USLE		Sediment Delivered		Sediment Delivered as % of Total Soil Loss
	total	%Change*	Tons/Yr.	%Change*	Tons/Yr.	%Change*	
1991 - With conservation measures	1,192 ac.	--	9,131	--	1,680	--	18%
1991 - No conservation measures	1,192 ac.	0%	25,893	+180%	4,411	+162%	17%
Where A>T revert to Forest	708 ac.	-40%	2,183	-76%	238	-86%	11%
Where A>T make A-T	1,192 ac.	0%	3,637	-60%	447	-73%	12%
1931 - No conservation measures	1,562 ac.	+30%	12,444	+36%	1,428	-15%	11%

* %Change Figures rounded to the nearest whole digit.

Changes in agricultural practices have less of an impact on estimated soil loss and sediment delivery than changes in landcover alone. Under scenario 3, reverting highly erodible cropped fields to forest cover (taking them out of production) would produce more water quality benefits than additional conservation treatment (scenario 4). In all scenarios, sediment delivery to streams was less than 20% of soil erosion from fields estimated by WIN using the


Dane County, Wisconsin
Black Earth Creek Watershed
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Garfoot Creek Subwatershed

Current Land-use with Agricultural Conservation Practices

Soil Loss and Sediment Delivery Rates for Cropped Fields

- ■ USLE gt T
- ▨ USLE le T
- ▧ Sed. Rate > 1

scale in miles

0 25 50 1

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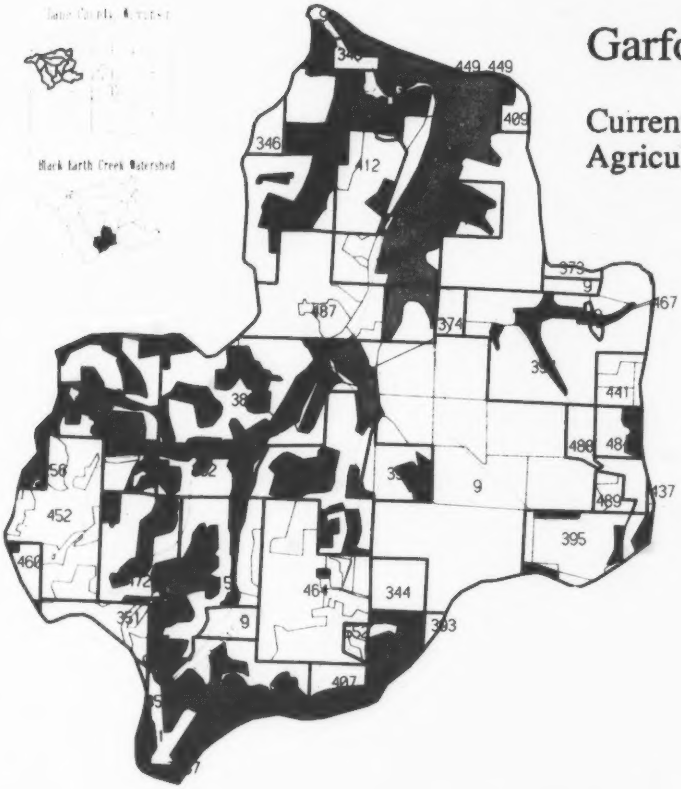
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Garfoot Creek Subwatershed

Current Land-use without Agricultural Conservation Practices

Soil Loss and Sediment Delivery Rates for Cropped Fields

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scale in miles

0 25 50 1

University of Wisconsin - Madison
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Land Information & Computer Graphics Facility

USLE. The first two scenarios exhibited higher sediment delivery as a percent of total soil loss as compared to the last three scenarios. This is probably due to two factors: (1) greater acreage of cropped fields in the study area; and (2) the type of fields contributing sediment. Fields closer to receiving waters tend to have higher sediment delivery rates because of increased surface water flow (from contributing upland fields) and shorter runoff travel distances. This relationship suggests that water quality impacts could be exaggerated if attention is focused only on USLE results. WIN attempts to factor in other variables influencing sediment transport including channel and overland flow characteristics and topography, thus providing a potentially more reliable and valid prediction of agricultural land use impacts on environmental quality. Of course, as with all models attempting to simulate the real world, accuracy and validity are a reflection of the quality of the model, the user, and the process of interpreting results.

CONCLUSIONS

Water quality is just one of many measures of environmental quality. Similar spatial and statistical analyses can be performed using other measures. This would expand the information base used by public officials to assess the impacts of alternative agricultural land management policies. GIS/LIS techniques can enable rural resource planners and policy makers to more effectively and efficiently evaluate different natural and cultural variables. Existing tabular models can be supplemented using GIS/LIS by adding a spatial and temporal dimension to investigations. In a digital environment, resources can be interactively manipulated to create alternative scenarios to illustrate the relative impacts of policy and planning choices. Large geographic areas can be more easily evaluated to assess the impact of decisions affecting resource quantity, distribution and quality. From a water quality perspective, model input preparation using GIS/LIS saves hours of manual work that would otherwise be necessary. Such improvements in scale, breadth and rate of assessment are significant and important improvements in planning capabilities.

The statistical summary demonstrates the role that agricultural practices and forestry play in determining environmental quality. Converting all highly erodible cropped lands remaining after implementation of federal conservation requirements to forest cover, would provide the highest level of water quality protection in the study area. However, water quality is only one measure of environmental quality and these benefits must be realistically weighed against other land use objectives including crop production and/or wildlife management. Forests also serve important functions such as providing habitat for wildlife. When cumulative roles are compared, the relative contribution of forest cover and agricultural practices to environmental quality may balance differently.

ACKNOWLEDGEMENTS

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The authors would like to especially thank Eva Serra who developed much of the base data for this project as part of her habitat suitability research. Aman Tandias is acknowledged for development of the Fortran algorithms that helped automate the flow-routing process.

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THE TOOLE COUNTY CONSERVATION PLANNING PROCESS

by
David Pratt
USDA Soil Conservation Service

What is the Soil Conservation Service? The Soil Conservation Service was established in the 1930's as a permanent agency of the United States Department of Agriculture. The SCS objective can best be summarized by this statement:

> "The mission of the Soil Conservation Service is to provide national leadership in the conservation and wise use of soil, water, and related resources through a balanced, cooperative program that protects, restores and improves those resources."

To do this SCS works with individuals, groups and units of government towards achieving their objectives for sustained use of soil, water,and related plant and animal resources. Assistance is given to local conservation districts in appraising their responsibilities, inventoring and analyzing resources and problems, and keeping updated long range plans. Assistance is available for all land uses including traditional agricultural and nonagricultural uses.

Conservation planning is a joint effort between SCS and the land user. The purpose of the planning assistance is to provide guidance and materials for land users to apply quality conservation and adequate treatment to the land. Meets the land users and SCS objectives. Leads to resource management systems provided through effective follow-up. Recognizes soil productivity, water quality, fish and wildlife habitat and environmental concerns.

The ten elements of the planning and implementation process.

1> PROVIDING INFORMATION. Informing people how SCS can help them.

2> REQUESTING INFORMATION.

3> DETERMINING OBJECTIVES. Help landusers understand their problems and broaden objectives.

4> PROVIDING RESOURCE INVENTORY DATA. SCS prepares and/or provides information such as soils, range sites and condition class, land use, water management, critical treatment areas, environmental studies, etc.

5> INTERPRETING, ANALYZING AND EVALUATING RESOURCE INVENTORY DATA. Assist the decisionmaker in analyzing the data as related to the stated objectives.

6> DEVELOPING AND EVALUATING CONSERVATION ALTERNATIVES.

7> MAKING DECISIONS. Selection of desired alternatives.

8> DOCUMENTING DECISIONS. Written record.

9> IMPLEMENTING DECISIONS. Installing the selected resource management systems.

10> REEVALUATING AND UPDATING. Planned follow-up.

The major inventories we use in Toole County are soils, land use, soil erosion properties, range inventories and cropping systems.

The producer is provided with all the above information in the planning document. One of the most useful tools for the producer is the air photos or maps.

A conservation system must meet some minimum resource management criteria. The required conservation practices for a basic system on nonirrigated cropland would be Conservation Cropping Systems and Crop Residue Use. Supportive practices may include conservation tillage, stripcropping, field windbreaks etc. Some of the normal resource concerns addressed are erosion, water conservation, animal waste and ag. chemical management.

Recently with the Food Security Act of 1985 and the 1990 Food, Agriculture, Conservation and Trade Act, farmers involved in the production of annual commodity crops are required to follow an approved conservation plan. Because of the dependence on farm program payments conservation planning became a requirement for most producers. In Toole County approximately 98% of all producers participate in farm programs and over 95% of the land needs treatment under the Food Security Act. The Food Security Act has four major components, Conservation Compliance, Conservation Reserve Program, Sodbusting and Swampbusting.

For many producers their first exposure to conservation planning came about as a result of the Food Security Act. This provided SCS with a tremendous opportunity to assist land owners with resource management plans. It also provided an obstacle - few of the new contacts knew what a conservation plan involved nor did SCS know how to deal with such a huge workload. Much of the initial contact was made by work with small groups of farmers. With the groups we tried to discuss what is included, the benefits and introduce them to the SCS.

One of the specific tools used for the FSA planning was the Teton Soil Erosion Program. This computer program is used to calculate residue and soil and water erosion for dryland cropping systems. It can evaluate both the present condition and planned conditions.

Financial assistance programs have been an important part of getting conservation on the ground. Several cost share programs are available to help defray the producer's cost of implementing conservation practices. These programs can target specific resources, be single practice and year or be multiple practice contracts to cover an entire operating unit.

In closing, if I could leave you with two thoughts. Regardless of the incentives the conservation plan must be the land users'. The plan must focus on their needs and objectives. A reasonable objective may be to remain eligible for the farm programs. The producer must be involved in the entire process. And secondly, the planning process is open ended. In the initial development of the plan, steps must be included to facilitate follow-up.

ELEMENTS OF A SUCCESSFUL REGIONAL/MUNICIPAL CONSERVATION PLAN

by
Peter Entz
Manitoba Agriculture

A regional or municipal plan can assist in the delivery of soil conservation or resource programs. There essentially are six elements that could make a regional plan.

1. Describe the objective of the project. In the area of soil and water conservation we would be looking at sustaining the soil and water resource, and providing wildlife habitat where suited in an agricultural setting.

2. Identify the issues, that is wind erosion, water erosion, crop rotation, water use, etc.

3. Identify solutions.

4. Target activities. I think #3 and #4 go hand-in-hand. In a municipal plan you have the opportunity to look at the whole landscape within that geography and to see where you get your biggest bang for your buck.

5. Probably the most critical is the communication. We all have an idea of what we want to do but we need to tie that in with the needs of the community. Again this brings in the people component, the local governments, the rate payers and the larger goals of society.

6. The last element is activities. The plan will do nothing if it just sits on the shelf. It has to go out and make things happen and this is where conservation programs like Farming for Tomorrow in Manitoba fit into the picture. The local delivery mechanism for ensuring that the objectives and target areas are dealt with. Along with results there is communicating these back to the local government and individual farmers.

Two tools that we see as being necessary are soil survey information and land use/land cover (remote sensing data). Both these tools can be used on a computer or a hard copy. Essentially, they highlight the resources that are available and the land use and management practices in that area. With just those two factors a clear picture will evolve in terms of what activity needs to happen and where multi-resource opportunities exist.

ELEMENTS OF A SUCCESSFUL REGIONAL/MUNICIPAL CONSERVATION PLAN

by
Bill Poole
Ducks Unlimited Canada

Over the past five years, I have had the opportunity to be involved in two different conservation planning processes in Manitoba. I'd like to give you a very brief description of each of them and then summarize a few common features that may give us an indication of at least some of the elements in a successful regional/municipal plan. It's going to be a real challenge to try to do all that in the time Leon told me was available, but we'll give it a try!

There are now six conservation districts in Manitoba, each responsible for the prudent use of the resources within their boundaries. Because one of their primary responsibilites is water management, all are at least partially organized on a watershed basis and cover more than one municipality.

Because they have a wide mandate - soil and water management, wildlife habitat, public education and even historic resources in some cases, - a broadly-based process was used to develop each district's 20-year management plan. The planning process was led by local board members - all of whom are appointed by the member municipalities - with the assistance of staff from the Manitoba Conservation Districts Authority.

(OH 3) As a first step, the board determined the resource management issues and options they felt were most important, circulated them to all residents and then presented them at a series of public meetings.

(OH 4) Since all but one of the districts had been operating before the planning process started, those "issues and options" were usually presented as questions to stimulate public response. Basically, the board said "This is what we have been doing" and then asked "Should we be doing more in this program, less in that one, or are there new program areas we should investigate?"

(OH 6) Based on public response to those questions and on their own experience, they then prepared a draft management plan and circulated it to all residents. Usually, that was followed by more public meetings to discuss the draft plan.

(OH 9) The process culminated with the production of a final management plan which included estimates of the amount of money that would be required for the first five years. Those estimates were used to prepare annual budgets as implementation of the plan began.

The agencies involved in implementing the North American Waterfowl Management Plan also went through a planning process prior to beginning program deliver. Although the processes differed somewhat from province to province on the prairies, I'll mention some of the highlights of the one used in Manitoba to illustrate the general approach.

Slide 1 Because the NAWMP is based on the principle that certain pre-determined waterfowl population goals must be met, its landscape planning process began with computer modelling. Those models helped determine the mix and scale of programs needed to reach the goals and also provided an estimate of the manpower, dollars and other resources that would be needed.

Slide 2 The selection of target areas for program delivery - based on satellite information and other data sets - was another fundamental requirement.

Slide 3 Based on that information, the top 245 townships in Manitoba's pothole region were identified and prioritized.

Slide 4 It is, however, politically more expedient to deliver programs in Manitoba by municipality rather than by township, so the target area was rounded up to 48 municipalities.

Slide 5 The next step involved priorizing the 48 R.M.'s into smaller, high-ranked groupings centered on logical locations for field offices. Selecting these initial primary target areas allowed us to use our field staff more efficiently. It also led to the preparation of more detailed landscape plans for those smaller areas.

Slide 6 Color-coded maps, based on wetland density and diversity, were produced for each of the primary target R.M.'s to assist our field staff in focussing programs on the most productive habitats. In addition, landowner surveys were conducted in each primary target R.M. to familiarize residents with our program options and to get some measure of public interest in them.

At first glance, these two planning efforts may not appear to bear any similarity to each other. Although the techniques used do differ widely, there are what I would call some fundamental principles that I feel apply to both.

Firstly, both are based on knowledge of the local area. For the conservation districts, that arose primarily from the knowledge and experience of local people. In the NAWMP plan, it's based on the habitat characteristics needed to produce a desired result.

Secondly, both plans have set themselves clearly defined goals. It is not enough simply to know what resource inventory is available; resource planners and managers must also know what they wish to achieve.

Lastly, and perhaps most importantly, both have taken pains to ensure that the public they hope to work with is aware of their plan and the reasons behind it. Resource management programs which are not known to, and supported by, their public clients are doomed to failure.

ELEMENTS OF A SUCCESSFUL REGIONAL/MUNICIPAL CONSERVATION PLAN

by
Leon Marciak
Alberta Agriculture

Throughout the past few months, I have put together this presentation and basically it can be termed the six P's of planning. I'll mention them first: first one is Policy; second one is People; third is Programs; fourth is Practices; after Ben Niemann's talk, it's Personal Computers; and the last one is Pilot.

The importance of policy is significant in terms of working with the Government and working with the local municipalities because I believe you need an overall framework with which to develop your plan. Policy at the Federal, Provincial and Municipal level sets the direction for a conservation plan. The objectives, the principles, and the intangibles all fall out of the policy.

The people aspect in most cases is underrated. The motivation of people and the desire to accomplish conservation through a common goal is very powerful. The synergism developed to accomplish conservation locally and in professional working relationships can go a very long way even despite incredible obstacles. People therefore, should be the prime resource. I think that development of common goals is very difficult because of an individual's self interest. The self interest is put in perspective when individuals contribute to a team. Everybody can use better interpersonal skills. I think these skills are needed for effective and efficient conservation planning. Professionals need to develop leadership as well as technical skills.

The third is programs. We all are aware we are in the midst of the ending of the CASCI program. Dr. Hill's presentation noted the financial concerns of the farm sector and rural community. With the current fiscal environment, program managers, need to watch more closely our public expenditures. The programs and the direction to which money is directed, will certainly influence the planning process but I am optimistic again the efficiencies of programs and planning will come out in conservation planning.

The fourth is practices. The adoption of these practices through the planning process is an important end goal. I think this is where the regional/municipal planning context sets the stage for the on farm adoption of those practices. The conservation plan breaks the trail to talk to the producer. The plan also provides the relevant information in terms of the farm level and the municipal level. The plan assists in supporting the adoption of conservation practices and recommends the relevant practices to all farmers under similar circumstances.

Personal computers; we saw the benefits of information technology and I think we have to pursue that in some form, and I think with all of us not being children of the digital age, that we have to bring together small applications of the computer technology. We must think about the applications and how the information can be used before we get to the computer, model it by hand and apply it and then we can develop the computer applications. Special consideration also needs to be given to the computer as an education tool. To summarize, there are many opportunities in computing but these opportunities need to be managed properly.

The last is pilot, and that is test your applications. I think conservation planning from what we saw today is new. Plans just didn't happen, they evolved through a series of trial and error. We need to keep this in mind, you don't go out sit in a boardroom at a table, have a committee meeting and develop a plan. The plan is an ongoing process, and there are trials and errors that we have to go through to validate our direction. Involvement with the other five P's of planning make it work.

Thank you for the opportunity to present my perspective on the elements of a successful conservation plan to you.

ELEMENTS OF A SUCCESSFUL REGIONAL/MUNICIPAL CONSERVATION PLAN

by
Ian Dyson
Prairie Conservation Action Plan

I'm approaching this topic from a somewhat different vantage point than my fellow panel members. The Prairie Conservation Action Plan (PCAP) is a regional plan, but in a national rather than a provincial or state context. And it's a conservation plan, but one with a biological conservation focus as opposed to an agricultural conservation focus. Despite these distinctions, I feel there are some lessons that can be learned from what we're doing with the PCAP that likely have relevance for agricultural conservation planning in a municipal context.

The PCAP was developed during the period 1986-1988 by World Wildlife Fund Canada (WWF) in association with a broad number of stakeholders (including representatives of provincial government agencies from the three prairie provinces). The plan is a five year action blueprint, aimed at maintaining the biological diversity of the Canadian prairies and parkland, and was released formally by the governments of Manitoba, Saskatchewan and Alberta late in 1988. In response to the challenge posed by the PCAP, Alberta established the Prairie Conservation Coordinating Committee (PCCC) to encourage implementation of the recommendations of the PCAP.

The PCCC is an unlikely committee which in some respects breaks all the rules. It is over large and unwieldy with a representation that spans a wide range of values. We have some four dozen members with representation ranging from agricultural organizations such as Unifarm, the Alberta Cattle Commission and the Western Stockgrowers Association to environmental groups such as the Canadian Parks and Wilderness Society, the Alberta Wilderness Association and the Federation of Alberta Naturalists. Also included are the six regional planning commissions in prairie and parkland Alberta, utility companies, academia and a liberal representation of federal and provincial government agencies.

Despite having existed for only two years, the PCCC has already achieved some notable accomplishments:

> *The PCAP contains 10 broad goals and a number of subsumed action recommendations. Each and every PCCC member organization has identified for each goal and action recommendation action-oriented implementation measures that their organization is prepared to take. These commitments are ongoing and are renewed and updated annually. This has allowed members to "move the agenda forward" rather more than would otherwise likely have been the case in times of downsizing and fiscal restraint. Good examples of action in this category include the development of Environmentally Significant Areas inventories for rural municipalities, the development of endangered species management plans, and determination of the status and location of populations of rare species.
>
> *For specific action recommendations where there is a lot of consensus amongst members, the PCCC is pursuing action through work groups. To date, two have come to conclusion with significant results:

In response to a PCAP recommendation that agricultural field personnel, district agriculturists and wildlife biologists should receive training in the value and presentation of native habitat and all wildlife, a three day block course was conducted by the University of Calgary's Faculty of Environmental Design at Brooks. There were thirty participants, the course received excellent revues, and will likely become an annual event.

In response to a PCAP recommendation that a portion of Canadian Forces Base Suffield should enjoy significant status, the Department of National Defense and the Canadian Wildlife Service have agreed in principle to establish a National Wildlife Area.

Other working groups are currently underway dealing with topics including environmental education, monitoring wildlife and habitat in rural municipalities, and urban native prairie areas.

*A number of new initiatives have also been prompted by the PCAP and are being pursued by PCCC member organizations working cooperatively on a multi-partite basis. Examples include:

- -guidelines for petroleum and natural gas exploration, development and production on native prairie
- -retention of tax recovery lands as native prairie in rural municipalities

The above examples all illustrate cases where applied prairie conservation initiatives are being undertaken prompted by the existence of the PCAP and PCCC. In other words, if the criterion for a successful conservation plan is action on the ground then this initiative has produced results.

Recognizing the significant differences in kind between the prairie conservation initiative described above and a municipal conservation plan, I would argue that there are some generally applicable principles of relevance. I will focus solely on attitudes and approaches, rather than the technical requirements of a rational planning system, because I think these are the elements most often overlooked.

Try to involved everyone. Everyone includes all agencies exercising jurisdiction and all groups that have an interest in the outcome. It is tempting, but usually perilous, to push ahead with a select group that shares common objectives and values.

Have a very clear and well-defined sense of what you want to achieve. Do not try and solve all the world's problems. A specific and well-defined project will invariably spawn a host of secondary issues. An ill-defined and ambitious project will inevitably be swamped in unforeseen complexities.

Resist the temptation to manipulate the agenda and control the outcome. Make it clear what you want to achieve and the parameters within which you are working, but allow a lot of flexibility for participants to drive the project. Plans are not plays, so we shouldn't know how the final scene ends until we get there. If you do already know you're in the wrong business.

Take risks when it comes to trust. In any multi-partite excercise, you will face a lot of judgement calls regarding the sharing of information or the determination of strategies. Take risks in terms of participation and prepare to be pleasantly surprised.

Believe you can make a difference and be sold personally on the value of what you're doing. In the final analysis it doesn't matter if you're selling vacuum cleaners or coordinating the development of plans, if you are not committed, it shows.

Focus on applied results. The process and information exchange and procedures and practices and communication and networking are all fine, but never let the means become the end. If you're not affecting changes on the ground, you're not succeeding.

ELEMENTS OF A SUCCESSFUL REGIONAL/MUNICIPAL CONSERVATION PLAN
"The Saskatchewan Experience - So Far"

by
John J. Kiss
Saskatchewan Soil Conservation Association

Saskatchewan is a BIG place. Watching it roll by outside your car windshield, you wonder if you'll ever find Alberta. Your nightmare, standing alone beside a broken down car, left to mercy of the prairie sun, wind and dust from the summerfallow fields.

Saskatchewan has approximately 66 million acres of land used for agriculture. About 50 million acres is cultivated. In terms of agricultural potential about 19 million acres should not have been put to the plow (CLI class 5 & 6) and a further 11 million acres could be considered marginal for annual cropping (CLI class 4).

Approximately 44% of the presently cultivated land has a water erosion risk of moderate to severe. About 50% of the cultivated land has a wind erosion risk of moderate to severe. Add to this the area affected by some level of soil salinity, losses of soil organic matter, lowering natural fertility levels, decreased aggregation and soil tilth, overgrazing of rangelands and groundwater recharge problems and it should suprise no one that Saskatchewan has many land management problems.

To manage Saskatchewan's land base the province has about 60,000 farms covering 298 Rural Municipalities (RM) grouped into 43 Agricultural Diversification and Development (ADD) districts. With respect to soil conservation efforts these 43 ADD districts are grouped into 6 regions (Appendix 1). Each region encompasses about 11 million acres.

Based on the realities of geography and professional staff, it would be difficult to provide detailed conservation planning services to ADD districts, let alone RM's or individual farmers, however regional conservation planning is feasible.

To assist in the planning of land resource management programs in the 6 regions there are 8 professional staff per region organized into ad-hoc Regional Conservation Teams (RCT) (Appendix 2). These professionals come from government departments, university and non-government organizations and all have full-time jobs outside of the RCT. With particular attention to soil conservation, Saskatchewan has 12 full-time soil conservation professionals assisting with the implementation of soil conservation programs in the field.

To date, in Saskatchewan we have been successful in completing one small part of what I would consider a "Regional Conservation Plan", the identification of conservation concerns and opportunities on a regional basis (Appendix 3). This has been prepared by the RCT's and takes the form of a regional resource inventory map and report which have been complied into a provincial poster (copies of the poster can be obtained through the SSCA in Regina).

In Saskatchewan we are unsure what the future will bring with respect to planning efforts, but from my experiences to date, I put forward the following **key points to any such future planning efforts:**

OVERALL: LOCAL OWNERSHIP IS THE KEY! If the individual or group doesn't see the need or benefits, it will be a long, uphill battle for the professional staff. The battle will cost money, time and people - are you prepared to do a poor job that will produce little or no results? Are there sufficient incentives for local interest and ownership?

1) An individual or group must perceive the need and potential benefits of regional/municipal/farm conservation planning.

2) The individual or group must search out and define the problem(s) that need to be addressed. "Problems" must be clearly separated from "symptoms of a problem". A clearly defined "goals" for the planning must be set.

3) The identification of "resource management problems" must be multi-disciplinary in approach (soil, water, wildlife, urban, recreation, economic, social) and must be fully discussed by all involved.

   Consensus building and agreement on the problem(s) will be essential if the planning effort is to be beneficial.

4) A complete land/water/wildlife resource inventory must be compiled and members of the region/municipality/farm must be familiar with the resources of the area and how they are presently being used and/or managed.

5) With an understanding of the "real problem(s)" and the "overall goal", the individual or group should document what they would like to see the area/region look like (grasslands here, trees here, lakes here, creeks here, cultivation here, forage here, towns here, industry here, these types of wildlife, etc.).

   This "vision" should be a long-term view of the areas soil/water/wildlife ecosystem and where local farms/society/economy fit into the long-term use and management of the areas resources. Compare this vision to what you have discovered through the resource inventory and document the differences.

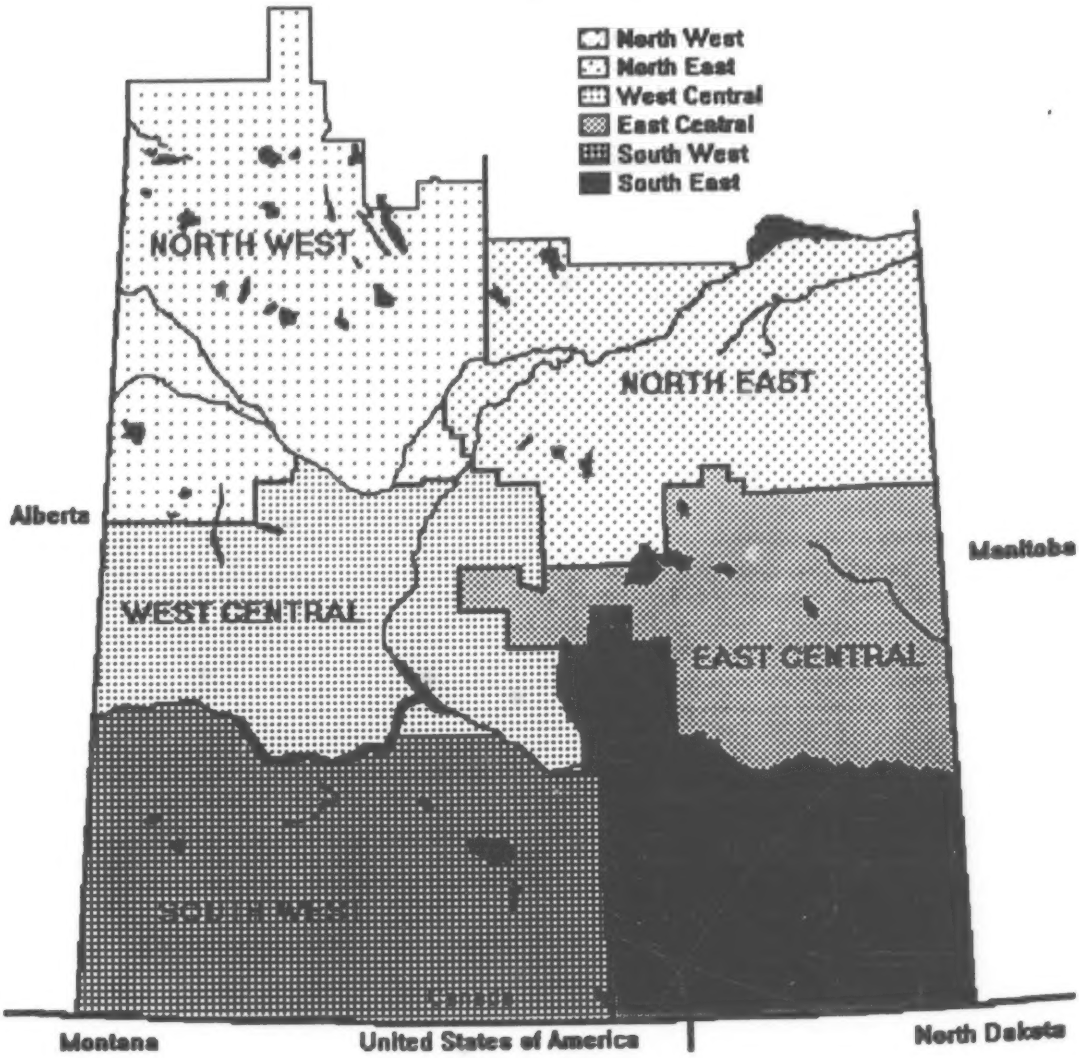
6) Once the differences between the "vision" and reality have been fully discussed, amended and agreed upon, the individual or group must decide what land management (or other) practices need to be changed (will require money, labor, time and creativity).

   It must also be decided how the group will handle the associated social and economic changes some of the land owners may experience. Develop a plan for changes necessary over time.

7) The plan being put into place must be continually monitored to ensure that the desired changes are happening and to identify what (if any) modifications to the plan are needed. This must be an ongoing activity.

"We shall never achieve harmony with the land, any more than we shall achieve absolute justice or liberty for people. In these higher aspirations the important thing is not to achieve, but to stive." Aldo Leopold (Naturalist)

Appendix 1: "Regional Boundaries in Saskatchewan"



Saskatchewan's 6 Agricultural Regions

North West
North East
West Central
East Central
South West
South East
NORTH WEST
NORTH EAST
WEST CENTRAL
EAST CENTRAL
SOUTH WEST
Alberta
Manitoba
Canada
Montana
United States of America
North Dakota

Appendix 2: "Regional Conservation Team List"

REGIONAL CONSERVATION TEAM MEMBERS

November 8, 1991

Participating Organizations:

1) Saskatchewan Rural Development-Extension Service (Co-Chairmen)
2) PFRA - Soil Conservation Service (Co-Chairmen)
3) Saskatchewan Soil Conservation Association
4) Saskatchewan Rural Development - Lands Branch, SRD
5) Saskatchewan Parks - Wildlife Branch, SPRR
6) Saskatchewan Institute of Pedology - Saskatchewan Soil Survey
7) Agriculture Development Fund
8) Ducks Unlimited
9) Extension Agrologist - Saskatchewan Rural Development

South West Region

1 Jim Pratt (Soils & Crops Agrologist)	Swift Current	778-8284
2 Paula Brand (Area Conservationist)	Swift Current	773-7255
3 Patricia Flaten (Regional Soil Conservationist)	Swift Current	778-8284
4 Zoheir Abouguendia (Regional Rangeland Specialist)	Swift Current	778-8294
5 Chris Dunn (Regional Biologist)	Swift Current	778-8205
6 Marie Boehm (Soil Surveyor)	Saskatoon	975-5638
7 Chris Ruschkowski (Regional Technology Transfer Coordinator)	Moose Jaw	694-3616
8 Doug Fraser (District Agrologist)	Regina	569-0424

North West Region

1 Eric Johnson (Soils & Crops Agrologist)	North Battleford	446-7475
2 Garet Cormin (Area Conservationist)	North Battleford	445-6217
3 Blair McClinton (Regional Soil Conservationist)	North Battleford	446-7650
4 John Chuey (Land Agrologist)	North Battleford	446-7468
5 Wally Kost (Regional Biologist)	Saskatoon	993-7942
6 Clint Hilliard (Soil Surveyor)	Saskatoon	975-5638
7 Bruce Bauman (Regional Technology Transfer Coordinator)	Saskatoon	933-5876
8 Dave O'Bertos (District Agrologist)	North Battleford	445-2575

North East Region

1 Roy Button (Soils & Crops Agrologist)	Tisdale	873-2585
2 Jason Fradette (Area Conservationist)	Melfort	752-4442
3 Garry Meier (Regional Soil Conservationist)	Tisdale	873-4290
4 Brian Harris (Land Agrologist)	Prince Albert	953-2784
5 Ed Kowal (Regional Biologist)	Prince Albert	953-2695
6 Mike Bock (Soil Surveyor)	Saskatoon	975-5636
7 Bruce Bauman (Regional Technology Transfer Coordinator)	Saskatoon	933-5876
8 Phil Curry (District Agrologist)	Melfort	752-2791

East Central Region

1 Zane Lewchuk (Soils & Crops Agrologist)	Yorkton	786-1508
2 Garry Bank (Area Conservationist)	Watrous	946-3303
3 Juanita Polegi (Regional Soil Conservationist)	Yorkton	785-1526
4		
5 Adam Schmidt (Regional Biologist)	Melville	728-4494
6 Rick Stushnoff (Soil Surveyor)	Saskatoon	975-5636
7 Ron Kehrig (Regional Technology Transfer Coordinator)	Saskatoon	933-5094

8 Brent Collins (District Agrologist)	Yorkton	782-2108

West Central Region

1 Larry Gramiak (Soils & Crops Agrologist)	Saskatoon	933-5285
2 Dennis Haak (Area Conservationist)	Rosetown	882-4272
3 Garth Patterson (Regional Soil Conservationist)	Saskatoon	933-5387
4 David Hryhor (Land Representative)	Saskatoon	933-5098
5 Wally Kost (Regional Biologist)	Saskatoon	933-7492
6 Allan Woloschuk (Soil Surveyor)	Saskatoon	975-4307
7 Bruce Bauman (Regional Technology Transfer Coordinator)	Saskatoon	933-5876
8 Philip Curry (Provincial Habitat Biologist)	Melfort	752-2791

South East Region

1 Ed Tanner (Soils & Crops Agrologist)	Indian Head	695-2263
2 Dean Smith (Area Conservationist)	Weyburn	842-4624
3 Bob Linnell (Regional Soil Conservationist)	Weyburn	848-2381
4 Larry Spearing (Land Agrologist)	Moosomin	435-3357
5 Karyn Scalise (Regional Biologist)	Regina	787-2461
6 Alvin Anderson (Soil Surveyor)	Saskatoon	975-5640
7 Chris Ruschkowski (Regional Technology Transfer Coordinator)	Moose Jaw	694-3616
8 Brent Collins (District Agrologist)	Yorkton	782-2108
9 Grant McLean	Carnduff	482-3432

Appendix 3: "Regional Soil/Wildlife Inventory and Opportunities"

SOUTHEAST REGIONAL CONSERVATION PLAN SUMMARY

Background

-ADD districts include Estevan (#1), Moosomin (#5), Indian Head (#6), Weyburn (#7), Regina (#14), Strasbourg (#37), and Carnduff (#41).

-There are four soil zones (Brown, Dark Brown, Black, Grey) within the region.

-The region is comprised of 6% sandy soils, 12% clay soils and 82% loam soils.

Current Management Practices

-The region has 11,890 farms ranging from exclusive grain to ranching and grazing operations. There is a good blend of mixed farms.

-Specific practices such as poor residue management, large field sizes, high summerfallow proportions and soil incorporated herbicides contribute to erosion.

Soil Degradation Issues

-Wind and water erosion, organic matter depletion, solonetzic soils and salinity are present.

Wildlife Opportunities

-Implementation of options available under the SOS program will reduce soil degradation and provide small areas of wildlife habitat.

-Shelterbelts provide an important food and cover source for many species of wildlife.

-Alternate tillage and fallow practices will improve nesting cover, increase winter food sources and improve pothole recharge.

-Forage establishment of marginal land will improve cover for wildlife.

-The North American Waterfowl Management Plan (NAWMP) identifies key program areas where the potential for waterfowl production is highest. The Prairie Care program will be implemented in these areas. The southeast region contains six ADD districts with a total of 28 RM's identified as having high waterfowl production potential. These are as follows:

    -ADD #1 (RM 34, 35, 64, 65)
    -ADD #5 (RM 91 - 93, 121 - 123, 151, 153)
    -ADD #6 (RM 94, 95, 124, 125, 154 - 156)
    -ADD #7 (RM 8, 39)
    -ADD #37 (RM 248, 279)
    -ADD #41 (RM 31 - 33, 61, 63)

-Components of the Prairie Care program include stubble mulch fallow, reduced tillage fallow, direct seedings, forage establishment, land lease and purchase, and other self initiated projects.

RCT Strategy

1) Wind Erosion:
   -Residue management, shelterbelts and tillage alternatives.
2) Water Erosion:
   -Grassed waterways, tillage and cropping practices, and erosion control structures.
3) Organic Matter:
   -Extended crop rotations and green manure.
4) Salinity:
   -Forage establishment and continuous cropping.
5) Awareness and Education:

F2

-On farm demonstrations, producer meetings and site tours.

6) Wildlife and Waterfowl:
   -Shelterbelts, tillage alternatives and cropping practices.

SOUTHWEST REGIONAL CONSERVATION PLAN SUMMARY

Background

-ADD districts include Assiniboia East (#2), Assiniboia West (#3), Shaunavon (#4), Moose Jaw (#8), Swift Current (#9), Maple Creek (#10), and Leader (#11).

-The climate is sub-arid to semiarid, with precipitation ranging between 290 and 380 mm.

-Most soils in the southwest are classified as Brown or Dark Brown Chernozems.

-The region is comprised of 12% sandy soils, 11% clay soils and 77% loam soils.

Current Management Practices

-Wheat-fallow is the most common rotation.

-There are 11,850 farms in the region.

-Summerfallowing is practiced to store moisture, control weeds and release soil available nitrogen.

-Soil conservation is intimately related to market forces and cropping practices.

Soil Degradation Issues

-The most important issues are wind and water erosion, salinity, soil organic matter decline and to a lesser extent solonetzic soils.

-Excessive cultivation in fallow fields and overgrazing of native rangeland leases the soil prone to erosion.

-A high risk of soil salinity exists for 38% of the land.

-Approximately 42% of the organic matter in the Brown and Dark Brown soil zones has been lost since the start of cultivation. Organic matter oxidation may contribute to the greenhouse effect.

Wildlife Opportunities

-Shelterbelts provide important habitat for many species of wildlife.

-Management of tame and native forage stands near selected drainage areas may be eligible for funding from Saskatchewan Parks and Renewable Resources (SPRR).

-The lease or purchase of critical wildlife habitat will be considered by SPRR.

-Retention and restoration of upland habitat will be promoted.

-The North American Waterfowl Management Plan (NAWMP) identifies key program areas where the potential for waterfowl production is highest. The Prairie Care program will be implemented in these areas. The southwest region contains four ADD districts with a total of 14 RM's identified as having high waterfowl production potential. These are as follows:

   -ADD #2 (RM 40, 70, 71, 102)
   -ADD #3 (RM 103)
   -ADD #8 (RM 100, 101, 131 - 133, 163, 164, 194)
   -ADD #9 (RM 165)

-Components of the Prairie Care program include stubble mulch fallow, reduced tillage fallow, direct seeding, forage establishment, land lease and purchase, and other self initiated projects.

RCT Strategy

1) Erosion and Organic Matter Losses:

-Practices that will conserve crop residue, including green manure, extended crop rotations, reduced tillage and chemfallow. Extended crop rotations are higher risk and should include snow trapping practices.

-Stripcropping and field shelterbelts.

2) Salinization:

-Factors influencing dryland salinity include climate, chemistry, soils, hydrogeology and mans' activities.

-The PFRA and the U. of S. have shown that artesian and side-hill systems are the main hydrogeochemical models causing dryland salinity in southwest Saskatchewan.

-Effective remedial measures can only be recommended after the processes causing salinity are understood.

-The cost to diagnose and prepare on-farm plans to control salinity is approximately $20 to $25/acre.

3) Solonetzic Soils:

-Treatments for solonetzic soils may involve deep ripping, deep plowing and/or the addition of chemical amendments.

-Ripping soils under certain situations may induce soil salinization. A detailed salinity study may be required prior to ripping.

EAST CENTRAL REGIONAL CONSERVATION PLAN SUMMARY

Background

-ADD districts include Yorkton (#12), Melville (#13), Kamsack (#18), Canora (#19), Wynyard (#20), Fort Qu'Appelle (#39), Kelvington (#42), and Watrous (#43).

-Dark Brown, Black and Grey soils are found within the region.

-The region is comprised of 10% sandy soils, 5% clay soils and 85% loam soils.

Current Management Practices

-There are 11,280 farms in the region.

-Summerfallow varies from 17 to 40% of the area.

-Cropping practices are variable, but mixed farming is common.

Soil Degradation Issues

-Practices contributing to land degradation include the clearing and drainage of marginal land, increasing field size, unnecessary summerfallow, soil incorporated herbicides, excessive tillage and stubble burning.

Wildlife Opportunities

-Clearing of native habitat, intensive cultivation and drainage of wetlands limits the ability of land to support wildlife.

-Establishment of permanent vegetation such as grassed waterways, salinity plantings and shelterbelts will benefit wildlife by providing food and shelter.

-Standing stubble provides a fall food source and spring nesting cover.

-The North American Waterfowl Management Plan (NAWMP) identifies key program areas where the potential for waterfowl production is highest. The Prairie Care program will be implemented in these areas. The east central region contains seven ADD districts identified as having high waterfowl production potential. These are as follows:

  -ADD #12 (RM 211, 213, 244, 245)
  -ADD #13 (All RM's)
  -ADD #19 (RM 275, 305)
  -ADD #20 (RM 276, 277, 278, 306, 307, 308)
  -ADD #39 (RM 186, 216, 217, 246, 247)

-ADD #42 (RM 336, 337, 367)
-ADD #43 (RM 281, 309, 310, 312, 313)

-Components of the Prairie Care program include stubble mulch fallow, reduced tillage fallow, direct seeding, forage establishment, land lease and purchase, and other self initiated projects.

District Summary

1) District #12 (Yorkton)

-High to severe water erosion risk west of Springside and Willowbrook.

-High wind erosion risk in the Willowbrook and Yorkton areas.

-Salinity affects up to 15% of the soils in the district.

-Conservation practices could include forages on saline areas, organic matter improvement on eroded knolls, tillage reduction and alternate methods of weed control.

2) District #13 (Melville)

-There is high wind and water erosion risk north of Melville. The solution is residue management through reduced tillage and extended crop rotations.

-Salinity is not as prevalent as in other areas, however extended crop rotations or forages should be used in problem areas.

3) District #18 (Kamsack)

-Severe water erosion risk exists on the western slopes of the Duck Mountains. High water erosion risk is present in the north and northwest part of the district.

-Severe wind erosion risk exists on cultivated areas near the Assiniboine River.

-Salinity in depressional areas, potholes and flatlands affects up to 15% of the southwest area bounded by highways 5 and 8.

-Conservation practices could include reduced fall tillage, fall seeded cereals, use of forages, and some contour strip farming. Extremely sandy areas should be targeted for field shelterbelts.

4) District #19 (Canora)

-High to severe water erosion risk exists southwest of highway 16 and north of highway 49.

-High wind erosion risk exists on soils in the Sturgis-Preeceville and Good Spirit Lake areas.

-Salinity occurs south of highway 49 in depressional areas and around potholes.

-Conservation practices to consider include crop residue management, green manuring, forages and shelterbelts.

5) District #20 (Wynyard)

-Sixty to seventy percent of the area, mostly south of highway 16 is subject to high or severe water erosion risk.

-Wind erosion potential and salinity affected areas occur mostly in the northeast portion of the district, north of highway 16.

-Residue management systems under both stubble cropping and fallow are of most importance. Contour strip cropping and forages on eroded knolls may also be used.

6) District #39 (Fort Qu'Appelle)

-Sixty to seventy percent of the district has high to severe water erosion risk.

-Conservation practices could include extended cropping, residue management and conservation fallow.

7) District #42 (Kelvington)
-High wind and water erosion risk on soils in the eastern half of the district.
-Salinity affects up to 15% of the western side of the district.
-A considerable awareness and educational program is necessary.
-Activities could include tree planting, conservation fallow, direct seeding and the use of forages and green manure.

8)District #43 (Watrous)
-The entire area is subject to some degree of salinization or high/severe wind or water erosion risk. Most of the severe saline areas are in grassland however other marginal areas are not.
-Residue management is necessary to reduce wind and water erosion. Conservation fallow should be demonstrated in areas using a crop-fallow rotation. Reduced tillage is necessary in areas using longer rotations.

RCT Strategy
-Conservation awareness
-Tillage practices and residue management.
-Alternate practices (annual barriers, snow trapping, shelterbelts, forages, green manuring and direct seeding).

WEST CENTRAL REGIONAL CONSERVATION PLAN SUMMARY

Background
-ADD Districts include Davidson (#15), Outlook (#16), Kindersley (#17), Saskatoon (#22), Biggar (#23), Kerrobert (#24) and Rosetown (#40).
-Approximately 25% of the land is in the Brown soil zone, 70% in the Dark Brown soil zone and 5% in the Black soil zone.
-Farmers have been quick to adopt previous conservation practices.
-The region is comprised of 19% sandy soils, 19% clay soils and 62% loam soils.

Current Management Practices
-There are 10,710 farms in the region.
-The dominant rotation is wheat-fallow. Other rotations include:
    -Lentils on fallow
    -Oilseeds on fallow, followed by a cereal
    -Continuous cropping on irrigated land.
-Frequency of tillage in the fallow year varies from two in the southwest to six or seven operations in the northwest.
-Erosion risk is increased on soils where soil incorporated herbicides are used.
-Application of 2, 4-D in the fall or spring is common in the west side of the region.
-Chemfallow is widely accepted but would be used more if the cost of herbicides was reduced.

Soil Degradation Issues
-Soil degradation issues for the region has been ranked as follows:
    1) Wind erosion
    2) Salinization, water erosion and organic matter loss
    3) Solonetzic soils and soil acidity
-Wind erosion is a prime concern because of its severity in the drier soil zones and the large number of acres affected (mostly fallow). It also has the greatest potential to manage using feasible practices.

Wildlife Opportunities

-Marginal lands provide the greatest potential for combining wildlife habitat with erosion control techniques.

-Seeding of shallow draws and waterways to forages creates additional space. Delaying hay cutting until after July 15 avoids nesting losses.

-The conversion of marginal cultivated acres back to pasture land or forage should ease the pressure on Crown pasture lands.

-Almost all native wildlife habitat in the area is subject to livestock grazing. Proper management of these areas is important for both agriculture and wildlife.

-The North American Waterfowl Management Plan (NAWMP) identifies key program areas where the potential for waterfowl production is highest. The Prairie Care program will be implemented in these areas. The west central region contains four ADD districts with a total of 11 RM's identified as having high waterfowl production potential. These are as follows:

-ADD #15 (RM 282)
-ADD #22 (RM 314, 341 - 343, 371 - 373)
-ADD #23 (RM 347)
-ADD #40 (RM 226, 256)

-Components of the Prairie Care program include stubble mulch fallow, reduced tillage fallow, direct seeding, forage establishment, land lease and purchase, and other self initiated projects.

RCT Strategy

1) Wind Erosion:

-High Priority: Residue management (herbicide substitution, wide blade tillage, low crown sweeps, reduced tillage speed and depth, direct seeding, straw spreading and snow trapping), grass/annual barriers, strip cropping and field shelterbelts.

-Low Priority: Annual cover crops, shelterbelt renovation and wildlife shelterbelts.

2) Water Erosion:

-High Priority: Residue management (herbicide substitution, wide blade tillage, low crown sweeps, reduced tillage speed and depth, direct seeding, straw spreading and snow trapping), contour strip cropping and field gully management.

-Low Priority: Annual cover crops and erosion/run-off control structures.

3) Organic Matter Enhancement:

-High Priority: Forage establishment
-Low Priority: Green manure and extended rotations.

4) Salinity:

-High Priority: Forage establishment
-Low Priority: Extended crop rotations and rehabilitation of saline areas.

NORTHEAST REGIONAL CONSERVATION PLAN SUMMARY

Background

-ADD Districts include Watson (#21), Hudson Bay (#25), Tisdale (#26), Melfort (#27), Wakaw (#28), Nipawin (#31) and Prince Albert (#32).

-The northeast region consists of Black and Grey soils.

-The region is comprised of 16% sandy soils, 23% clay soils and 61% loam soils.

Current Management Practices

-There are 8,800 farms in the region.

-Excessive trash, frost damage and weed control are prime concerns.

Soil Degradation Issues

-Wind and water erosion are evident over much of the cultivated land in the region.

-Salinity is affecting crop yields to the point that annual crop production is no longer possible in some localized areas.

-Soil organic matter is low in some soils, especially the Grey Wooded and Dark Grey soils which are common in the northeast.

-Conservation concerns by district are:

-Watson (#21); salinity, wind erosion, water erosion
-Hudson Bay (#25); organic matter, wind erosion
-Tisdale (#26); water erosion, wind erosion, organic matter
-Melfort (#27); wind erosion, water erosion, salinity
-Wakaw (#28); water erosion, wind erosion, salinity
-Nipawin (#31); organic matter, wind erosion
-Prince Albert (#32); wind erosion, organic matter, water erosion

Wildlife Opportunities

-Burning of trash and sloughs continues to reduce wildlife habitat.

-Drainage, both legal and illegal, continues to destroy habitat.

-The utilization of hardwoods by the pulp and paper industry is also contributing to habitat loss.

-Any agricultural practice that incorporates forages in the rotation will benefit wildlife.

-Serious consideration should be given to treating trees as a long term crop.

-Shelterbelts will provide habitat for song and game birds.

-Beaver ponds are excellent for stock watering purposes and sloughs serve to recharge aquifers.

-The North American Waterfowl Management Plan (NAWMP) identifies key program areas where the potential for waterfowl production is highest. The Prairie Care program will be implemented in these areas. The northeast region contains four ADD districts with a total of 20 RM's identified as having high waterfowl production potential. These are as follows:

-ADD #21 (RM 338 - 340, 368 - 370)
-ADD #27 (RM 398, 299, 428, 429, 458, 459)
-ADD #28 (RM 400 - 402, 430, 431)
-ADD #32 (RM 460, 461, 463)

-Components of the Prairie Care program include stubble mulch fallow, reduced tillage fallow, direct seeding, forage establishment, land lease and purchase, and other self initiated projects.

RCT Strategy

1) Wind Erosion Control:

-Conserve residue through chemical substitution and appropriate tillage practices (noble blade, rod weeder, low pitch shovels and reduced tillage speed).

-Change cropping practices by including more stubble cropping, green manuring and the use of forage crops in rotation).

-Establish shelterbelts on seriously eroded land.

2) Water Erosion Control:

-Shape and grass field gullies to minimize water erosion from runoff.

-Change tillage and cropping practices to maintain cover on sloping land.

-Construct erosion control devices.

3) Salinity Improvement:

-Establishment of permanent forages.

-Reduction of summerfallow (continuous cropping).

4) Organic Matter Enhancement:
   - Extended crop rotations.
   - Trash management.
   - Forage as a green manure or rotation.
   - Reduction of tillage.

5) Education and Awareness:
   - To include meetings, field days, publications, newsletters, surveys, media coverage, trade fairs, competitions and documentation with pictures.

NORTHWEST REGIONAL CONSERVATION PLAN SUMMARY

Background

-ADD Districts include Rosthern (#29), North Battleford (#34), Unity (#30), Shellbrook (#33), Lloydminster (#35), Meadow Lake (#36) and Turtleford (#38).
-The soil zones within the region include Dark Brown, Black and Grey.
-The region is comprised of 22% sandy soils, 2% clay soils and 76% loam soils.
-In a recent survey (Heinrichs, 1989) producers rated wind erosion as the most serious degradation problem.

Current Management Practices

-There are 8,860 farms in the region, of which 4,000 are beef cow producers.
-Fallow acreages have shown a declining trend, however this may be reversing due to the current economic and climatic situation.
-Crop residue surveys conducted by the PFRA have shown that a high percentage of fallow fields in the Black and Grey soil zones were as susceptible to severe wind erosion as fields in the Brown soil zones.
-The following constraints exist:
    -Lack of a soil conservation infrastructure.
    -Motivation and producers' attitudes towards soil conservation.
    -Competing programs for ADD boards.
    -Negative attitudes towards wildlife conservation in term of crop depredation.

Soil Degradation Issues

-The following areas have been identified as having a severe water erosion potential: the Meadow Lake-Pierceland area; the Senlac-Macklin-Denzil areas; the Hillmond-Greenstreet area; the Baldwinton-Carruthers area; and the Whitkow area.
-According to the Wind Erosion Risk Map, areas with severe wind erosion risk include: the Senlac-Rutland-Winter area; the Maidstone-Paynton area; the Rosthern-Hague area; the Canwood area; and the area east of Blaine Lake along the North Saskatchewan River.
-Poor organic matter status of Grey Wooded soils.
-Largest concentration of acid soils in the province.
-Soil salinity is a problem in the Rosthern and Unity districts.
-There are 300,000 acres of Crown land under cultivation in the region, most of which are prone to soil erosion and degradation.

Wildlife Opportunities

-Marginal lands provide the greatest potential for combining wildlife habitat with erosion control techniques.
-Seeding of shallow draws and waterways to forages creates additional space.
-Delaying hay cutting until after July 15 avoids nesting losses.
-The conversion of marginal cultivated acres back to pasture land or forage should ease the pressure on Crown pasture lands.

-The North American Waterfowl Management Plan (NAWMP) identifies key program areas where the potential for waterfowl production is highest. The Prairie Care program will be implemented in these areas. The northwest region contains five ADD districts with a total of 17 RM's identified as having high waterfowl production potential. These are as follows:

- -ADD #29 (RM 403, 434, 435)
- -ADD #30 (RM 410, 411)
- -ADD #33 (RM 464)
- -ADD #34 (RM 436, 437, 466, 467)
- -ADD #35 (RM 439, 440, 442, 470 - 472, 502)

-Components of the Prairie Care program include stubble mulch fallow, reduced tillage fallow, direct seeding, forage establishment, land lease and purchase, and other self initiated projects.

RCT Strategy

-Green manuring, forages in rotation and extended cropping are possible demonstrations to improve the organic matter status of Grey Wooded soils.

-Due to the lack of an economic response to liming (Haak et al, 1989) this practice is not recommended unless perennial legumes are being grown.

-Salinity projects in the Rosthern and Unity districts should be developed based on recommendations from Les Henry's salinity team.

-Medium term activities include:

- -Train ADD board technicians
- -Train ADD board secretary/treasurers
- -Develop a soil conservation seminar on Grey Wooded soils.

MUNICIPAL PLANNING
Panel Discussion Questions and Answers

Moderator: Jack Howell, Alberta Agriculture

NOTE:The alloted time during the Panel Discussion did not permit answers to all of the following questions. Answers to the questions were provided after the Workshop by the panel members at the request of the editors.

1. **Q** "Planning" may impose limits on rights of individuals/corporations to use land and water (environment) as they wish. Can conservation planning be successfully developed to minimize the constraints on the rights of individuals without compromising environmental objectives?

   A Leon Marciak - I am optimistic that conservation planning can assist in the resolution of conflicts. The first step in resolving conflicts is to find some common ground. Through conservation planning common values can be inherently linked to individual rights. I would like to think of planning developing the constraints which are mutually agreed upon based on land capabilities overlayed with economic forces. I think conservation planning identifies limits to land use but also opportunities.

2. **Q** Leon: With respect to the Pilot Project with the County of Stettler, is there a plan to implement the plan? Has the County bought in to the plan with respect to offering financial incentives through property tax reductions to encourage appropriate conservation practices.

   A Leon Marciak - The Municipal Conservation Planning Pilot Project does have an implementation phase. However, under the current time frame (short term) that the plan will be developed, it is expected that this comprehensive plan will be taken to the County of Stettler Agricultural Service Board for their review. The level of acceptance will be through the Agricultural Service Board and their implementation on the priorities that have been determined locally. It is my hope that we are consistent with, and develop similar priorities from both the Municipal Conservation Planning Pilot Project and the Agricultural Service Board.

3. **Q** Leon: It has been mentioned several times today that no plan succeeds until it accelerates the adoption of conservation measures. Which of your "7 P's" provides the incentive for adoption of conservation practices of producers?

   A Leon Marciak - Planning, Process, People, Personal Computers, Principles, Practices and Programs. In my opinion the incentive for adoption of conservation practices by producers is through People. The motivation must come from within both from a delivery perspective and from an acceptance perspective. In order to get the information across you must have a sender and receiver. This is how I see conservation practices. The other components of planning must all support people adopting conservation practices.

4. **Q** Ian: Do you feel that the Northern Pocket Gopher has a niche in species diversity and would feel a program for its eradication would draw much reaction?

A Ian Dyson - All species have a niche in terms of species diversity. The pocket gopher doesn't have a high profile in prairie Alberta as it tends to favour heavy, moist soils. They are a localized problem on cultivated agricultural lands, especially vegetable gardens, but from an ecological point of view, they perform a useful role by bringing up and scattering subsoil and by burying stubble to form humus. They are also a key prey species for the long-tailed weasel which is considered a species at risk. There can be excessive populations on overgrazed improved rangelands, but they don't destroy native grasslands. Control measures are used locally, generally using poisoned grain. The 'pest' status of the species in Alberta is pretty low profile and while there have been local control attempts, there have not been calls for its general eradication.

5. **Q** John: How can we get municipalities and farmers interested in conservation planning? (considering our aging farm population and poor farm economy)

A John Kiss: I believe that we need a mixture of legislation to protect fragile areas (critical wildlife habitat, highly erodible lands, saline areas and some wetlands) and direct financial incentives to municipalities and farmers who prepare and implement conservation plans.

One method of providing an incentive for municipalities would be to provide repayment of any lost taxes due to conservation plan implementation. Responsibility for repayment of lost taxes would be borne by both urban and rural societies, through the provincial and federal governments.

For farmers, an incentive could be created if the Gross Revenue Insurance Program (GRIP) could be reworked to financially reward farmers who prepare and implement conservation plans.

6. **Q** Whoever Dares: Do regional plans suffer from not being a vehicle for delivering dollars to farmers?

A Leon Marciak - I am not sure of the complete hidden message of this question but I will attempt my interpretation. I do not know of any regional level plans that deliver dollars to farmers. What I can say is that regional plans should ensure that programs are effectively and efficiently delivered to the producers.

7. **Q** Have you (anyone) ideas of how to change GRIP to put it in line with the conservation objectives?

A John Kiss - At this point in time GRIP is not a simple program from both the farmers and governments points-of-view. In general, GRIP could be made more conservation positive by financially rewarding farmers for the preparation and implementation of a recognized farm plan (possibly in the form of a GRIP premium reduction). Pay-outs under GRIP could also be aligned to cover some costs involved in implementing some conservation measures (at set rates). GRIP could also be used to administer conservation programs such as the Permanent Cover Program (PCP).

The inclusion of forages (seed and feed) in GRIP would also be a very positive step toward making GRIP conservation positive.

A Leon Marciak - It should be recognized that there is to be an environmental evaluation of the GRIP program. I suspect that this evaluation will lead to the fact that GRIP did significantly influence cropping decisions away from conservation. I hear discussions from extension staff that GRIP turned good farmers into average farmers and that this program unfairly biased cereal cropping decisions over forage cropping decisions. There has been too much emphasis on a grain economy. Where the concern should be is where forages have been taken out in favour of cereals and the cultivation of marginal land without the needed and appropriate conservation practices. I trust the GRIP environmental evaluation will determine the level to which this occurred.

8. **Q** How do Municipal Soil and Water Conservation planning efforts incorporate other non-agriculture planning efforts, like Prairie Conservation Action Plan, NAWMP, wildlife management plans and so on?

A Leon Marciak - The Municipal Conservation Planning effort should and needs to consider the non-agricultural aspects. I would like to see that the planning activity become aware of the specific non-agricultural planning activities. The important aspect that I see is that the Municipal Planning effort can focus these studies and provide the context for them at the local level. This way the significance of an area from both agricultural and non-agricultural interests can be presented.

9a. **Q** Leon: What principal resource problems do you feel that regional planning could address?

A Leon Marciak - Land degradation, water quality and quantity, wildlife integration, these problems can be addressed at a municipal level.

9b. **Q** What priorities would apply? ie. wind erosion abatement, land use adjustment, use integration.

A Leon Marciak - The priorities would be set by the local authority. I believe the priority setting should be set by determining the severity, extent and location of the particular issue. A role for Municipal Conservation Planning may be to identify significant issues which may be hidden from the local perspective.

9c. **Q** What would be a number one priority and what kind of pilot project would be appropriate?

A Leon Marciak - To be honest, I personally do not have a number one priority. The plan should however, help to develop or direct us to a priority or better yet a series of priorities. In my opinion a well rounded approach may be more beneficial than tackling and spending all your resources on public enemy number one. There might be some opportunity to develop some synergies.

The number one priority would need to be determined locally. From the perspective of what kind of pilot project would apply would depend on the nature of the problem identified.

10. **Q** How effective was the regional planning process for conservation districts after the initial plan was completed? ie. is there a continuing reference to and use of the regional plan?

11. **Q** Leon/John: Is there a level of soil degradation where it is not feasible to apply conservation plans? Is it better to turn that land back to the Crown?

A Leon Marciak - I don't think that there is a limit to where conservation plans can be used. Though in extreme degradation cases as I infer from this question, the conservation plan may actually be called a reclamation plan. Remedial measures may have to be applied to arrest the degradation and restore the productivity. The conservation plan should also address whether the land use is appropriate. The land use assessment should come early in the conservation planning process. I believe that in some severe cases such as the land use is not appropriate, the land use may cause off site damage or the land has been abandoned, that crown ownership should be considered. There may also be non-government organizations interested in the land such as Ducks Unlimited, Fish and Game Association, Scouting, etc. Resource costs should also be considered in the determination of whether a parcel should reside in crown or private ownership.

A John Kiss - Critical wildlife habitat, highly erodible land, saline areas and some wetland areas should be crown lands. Very fragile or important ecological and hydrological resources must have long-term protection from our short-sighted political, management and economic systems.

12. **Q** There was an excellent question about GRIP and there have been a number of questions about farmer incentives. Isn't it a responsiblity of conservation planners to communicate the need for policy review to the policy makers?

A Leon Marciak - Further to the previous GRIP related question, I believe that conservation planning can develop a cleared picture of how policies impact landowner decisions. Through the documentation developed in conservation plans the decision process can be modeled with or without the program under consideration. It is then that we will be able to understand how to develop conservation based or at least conservation neutral programs.

13. **Q** Why does Alberta Government give fuel rebates to encourage tractor use, yet, Alberta Government gives money to groups to encourage tractor disuse?

A Leon Marciak - This question is analagous to a person using the wrong tool for the job. The tractor supplies the power for farm production. The fuel rebate program was put in place when petroleum prices were very high and this high price put a considerable burden on farm costs. We as conservationists need to ensure the farm tractor is used in a conservation friendly manner. We need to influence the farmer from a conservation perspective that the fuel rebate does not encourage excessive tillage.

14. **Q** Leon/John: Are regional/municipal plans necessary as a precursor of individual plans and why?

A Leon Marciak - In my view, regional and municipal conservation plans need not be precursors to on farm planning. Regional and municipal planning however, should be able to assist in developing recommendations related to off farm impacts and provide for effeciencies in delivery of on farm conservation plans where there are specific degradation concerns.

A John Kiss - It is my opinion that creating individual plans in the absence of municipal and regional plans will ultimately create friction between farmers and municipalities. The goals of the individual are often different from that of the local group or the society-at-large.

NORTH AMERICAN WATERFOWL MANAGEMENT PLAN AND CONSERVATION PLANNING

by
Dr. Morley Barrett
North American Waterfowl Management Plan

Good evening Ladies and Gentlemen. It is certainly a pleasure to be here this evening and talk to you about the North American Waterfowl Management Plan and conservation planning. Particularly, when there are so many agrologists and agricultural oriented people in the room, as a biologist this is a distinct pleasure.

In my presentation I want to touch bases with four aspects this evening. I want to talk about the basic review of the NAWMP. I want to talk about important relationships of the plan to agricultural interests. I want to look at some of the early initiatives and achievements under the Plan. And finally, I will discuss some areas where we can do some future business together.

First of all in terms of basic review of the North American Plan, I am going to be pretty brief. The Plan is a 15 year initiative to restore waterfowl population on a continental basis roughly to levels of the mid-1970's. And in practical terms we're looking at a doubling of current populations. We have specific population objectives for each of the species involved, but that's really not all that critical for this evening's presentation. I want to tell you and leave you with the understanding that the Plan is very much a partnership issue. It is arranged under joint habitat ventures throughout North America. We happen to be part of what is called the Prairie Habitat Joint Venture with Saskatchewan, Manitoba and Alberta. We have partners in terms of planning, partners in terms of the program, and partners in terms of funding. As an example, in Alberta, the partnership includes Alberta Agriculture, Alberta Forestry, Lands and Wildlife, Ducks Unlimited Canada, Wildlife Habitat Canada and the Canadian Wildlife Service. Each has similar or expanded partnerships and we do have a lot of other associations with organizations like PFRA.

With respect to funding, we receive financial support from the various Canadian partners as well as a lot of funding from U.S. sources. Roughly 2/3 to 3/4 of our funding comes from the U.S. with half of that amount coming from the U.S. federal government. So it is a very unique arrangement, and that's for projects in Canada. To give you a perspective of what we're talking about for budget, on the prairies we're spending roughly, as part of the 15 year plan, about 30 to 40 million dollars annually as part of the North American Plan.

I want to mention that we do have as the basis of our plan a document we call our prospectus for the Prairie Habitat Joint Venture. This is really an important guiding instrument to us. It describes the problems, it describes what we would like to do about it, some of our goals, some of our objectives, who is going to be involved, what the roles are going to be, where some of the funding is going to come from and even goes as far as to develop some principles. So, this dictates, in part, how we go about doing business. I guess as we've heard today, the essence of a lot of these things is to have a plan, hopefully a good plan in place. There are additional documents to expand from this and extend this, but the prospectus is really the conscience of the plan as far as habitat initiatives. I want to now move on to the area of the relationship of NAWMP to agriculture. This is not tokenism, this is important. We recognize the need to relate to landowners and agriculturists and agricultural policies as one of the fundamental needs of the plan. In fact most elements of our direct delivery, things we do on the ground, represent probably 3/4 of our total budget. Our direct programs deal with landowners and farmers one-on-one. Those programs under the program name Alberta Prairie CARE are delivered by DU Canada and Alberta Forestry, Lands and Wildlife in this province. We're not simply an organization or program that perhaps has brochures but doesn't have any on-ground program. We have a lot of on-ground programs and our waterfowl objectives depend on the on-ground programs. In typical programs we enter into agreements, long-term agreements for compatible land use. We'll lease land for 10 years to plant nesting cover, we'll purchase some of the marginal lands as part of the program, establish demonstrations and many other things. I want you to remember, because it may not be intuitively obvious, that a lot of the emphasis of the North American Plan is on the development of habitat on uplands, not on wetlands. It's the nesting habitat which is a critical element in terms of population recovery for waterfowl. We have to work in areas with high pothole densities and other water sources to attract breeding birds. Survival of nests and survival of broods is extremely important to population recovery and that's where the majority of funding is going.

I alluded to it today but I want to give you very strong examples of how the program relates to waterfowl in a very fundamental sense. In this document we have a section entitled From Vision to Principles. We have 16 guiding principles in the North American Plan and 5 of them refer very directly and principally to agriculture. Agricultural interests form some of the fundamental basis of the planning. I will give you a couple of examples of these, 1) Implementation of the Habitat Joint Venture will focus on maintaining a healthy and diverse landscape through integrated land use management to provide waterfowl and agricultural benefits. 2) All agencies or sectors having major interest in waterfowl, soil and water resources will be encouraged to participate in planning, implementing and evaluating the venture to promote the integration of public and private soil, water and habitat conservation programs having common objectives. 3) Agriculture extension programs to demonstrate, promote and implement conservation farming techniques beneficial to waterfowl will be a major component of the Plan's habitat ventures. I don't know how more plainly or specifically we can relate the Plan to agriculture and agricultural initiatives. In recognizing this need, some partners, Ducks Unlimited principally, have hired agrologists and some are in the room today. We've also had full membership of participation from agricultural agencies in some of our key management committees such as the Alberta Board of Directors. Our Waterfowl Technical Committee has an Alberta Agriculture member as does our Communications Committee. Bob Wettlaufer, PFRA, sits on the Prairie Habitat Joint Venture Advisory Board. So NAWMP is very much open to agriculturists and they play a leading role in terms of decision making.

Another area I want to move on to now is to outline some of the early initiatives and achievements of the Plan. It will touch base very quickly on a number of things. I just want to reiterate that the majority of our direct programming was through the Alberta Prairie CARE program which includes all our leases or land negotiating or habitat development. This is our biggest single success and represents the biggest single chunk of activity we have out there. It's in place now to be delivered from the prairies and southern Alberta through the aspen parkland and the Peace River parkland. Similar programs are being delivered across the prairies in some of the key waterfowl target areas.

Another one I want to mention is the Policy Adjustment Task Force which is a little different. Len Fullen from Alberta Agriculture has been Alberta's main contributor to that and he's been a very significant leader in putting that program together and working with other interests across the country. It doesn't take a whole lot of brain power to recognize that some of the policies in place at the municipal, provincial or federal level are operating at cross purposes to each other. PCP II and the North American Waterfowl Management Plan program are trying to put habitat in the ground, permanent cover, and to stabilize vegetation in some of the vulnerable soils. You look at these programs and say how are they going to relate to programs like GRIP and other things which encourage greater acreages of annual cropland? They won't, they're in conflict. Part of NAWMP is to look at opportunities we have for input to those programs and make them, as we said earlier, more environmentally friendly.

I want to specifically mention the PFRA, PCP II program. We had the opportunity in this past year to work on the actual programming and do a joint presentation in terms of the brochure on the new program where the last couple of pages were devoted to NAWMP land-use programs available to those participants in the PCP II program. We think this cooperation has been an excellent initiative that allowed the provincial and federal people to get together from different disciplines-agriculture and wildlife. It also served to benefit the landowners, which is the most important, as well as the environment. So I commend the people involved for showing us how the minds can get together in a timely fashion so that the programming can reflect the various interests in a non-competitive way which will increase efficiency and certainly serve the landowners.

Leon didn't toot his horn too loudly on the Stettler Municipal Planning Project. That's another one that NAWMP is supporting and participating in. We think it is a good one. We were pleased to be involved there because they had the foresight to get a broad range of interests and a broad range of disciplines involved at an early stage and the plan will evolve with all the different perspectives in mind. We think it's particularly important because it might serve as a template, an example as to how planning could proceed in other municipalities down the road. We are pleased to be involved and we're very hopeful of the product to come forward.

Another initiative we hope to be starting in early 1992 as part of the North American Plan, is a socio-economic study. We want to know how our programming impacts our participants, how it impacts on rural residents, what the attitudes and values of the residents toward the Plan are, how we can adjust our programming if necessary to make it more acceptable or friendly to some users and what the general public attitude, knowledge and response is to the program. So we'll be polling, having focus groups and doing some general survey work for the population at large in this coming year. The expectation is that this type of study will have to be repeated every few years to fine tune some of the delivery and give us feedback and evaluation on how we're doing. This would be done in cooperation with the Rural Economy Department of the University of Alberta.

I want to briefly mention the Alberta Wetlands Policy and commend the initiative of the Water Resources Commission in Alberta in terms of reviewing the policy and getting the vast amount of public and agency input. A lot of our NAWMP partners were extremely interested in providing input to that policy. The policy is likely going to, hopefully, come forward to ensure and recognize the importance of wetlands to the rural community and to other interest groups and provide guidelines for the management of wetlands in this province. So we're very encouraged by that initiative.

There is another initiative that I want to mention to you. We are planning in early 1992 to launch the non-waterfowl program in conjunction with the NAWMP. Waterfowl will always drive the core program but there are a lot of other interests involved as well. For example, we have an obligation to ensure that we don't impact negatively on other key species or habitats as part of our program delivery. We also want to look at opportunities to acquire, develop and manage lands to benefit other key species. A prime example would be some of our wetlands. Our partners, our funders, the general public, and the U.S. Congress will support this initiative to broaden the Plan. It is our intent to make it happen.

I want to move on to another area where I think we have some room for improvement. I think that the fact that I see more and more wildlife content and other content creeping into these meetings is great, but we still have a ways to go. We still have too many plans, proposals or projects coming with a fairly narrow focus in terms of what they want to achieve and in terms of the input. Perhaps government staff, government agencies themselves and some of our partners are among the worst offenders. I think the public expects, and based on some of the national survey data, are starting to demand that broader environmental concerns be part of the fundamental decision making.

There are some examples where we can gauge the public's mood. Big programs on a national scale like James Bay II in Quebec represent a mammoth engineering challenge. However, now it's really at a state where the issues aren't technical at all. It's not just built to export power and import money. The issues now are environmental and native concerns. It's funny how things that weren't perceived as a major part of the equation could end up controlling the direction that we go in. If we come closer to home, we can talk about things like the Old Man Dam in Alberta, the Rafferty-Almeda Dam, forestry practices throughout Canada, pulp mills and rivers. All of these things can develop somewhat out of context and out of phase, if you will, with the public attitude toward some of the broad environmental concerns. I think that these types of initiatives must be evaluated with a broader criteria at the planning stage. If we don't do it we're going to continue to hear the public wrath in the press and in the courts. It's a matter of programming, in many cases, trying to catch up to public opinion. We're not leading, we're lagging in many cases. I think we've got to make greater efforts to involve broader perspectives and to have their input meaningful; the public really expects no less.

I am going to provide a local example and I hope it doesn't make too many people in the room squirm. The issue is pothole consolidation. An article in the October issue of Agrinews entitled "Pothole Consolidation Maybe Your Best Bet" eluded to the fact that this was potentially a useful thing to do for wildlife and suggested in the way it was presented, that DU was involved in this as a partner and supporter. However, the same month, October 1991 another article written by the chief provincial biologist for Ducks Unlimited reiterating Cowan's previous comments that consolidation is really another word for drainage. Ducks Unlimited never has or never will support programs like Pothole Consolidation. My point in bringing this up is not to embarrass anybody or put anybody on the spot, but to ask how well are we communicating? How well are we understanding the other person's perspective? These agencies have more interaction probably now than they have ever had in their history. We have to do better at really understanding where each other is coming from before we start having public lobbying and a cross-firing session. I think it's really unfortunate to us all and I include the wildlife agencies equally if we can't get our message across very clearly. It is not to say that Alberta Agriculture or anybody else will not do pothole consolidation now or 20 years from now. Hopefully they won't but to have them justify the approach from a wildlife perspective is the hard part and at odds with waterfowl biology.

Another example I want to bring up, and this maybe a little more upbeat is, the issue of on farm conservation planning. We've heard a fair bit about it today and some of the initiatives. We're going to hear more about it tomorrow. It started primarily as an agriculture initiative over the first couple of years. But as recently as last week Tom Goddard in charge of the Alberta program has met with the NAWMP Centre and some of the partners, and invited participation by the wildlife community and we think that's a really important step. On farm conservation planning is an important area with a lot of potential. In fact, Tom, it would be useful to think in terms of the potential for a special area pilot project designed with broad resource interest in on farm conservation planning by the end of 1992. Some cost-shared potential exists between the agricultural community and other wildlife agencies. I think it's something that really holds a lot of promise for us.

I would like to highlight another area where there is potential for some broader involvement. We've had a lot of good rhetoric here today and some real challenges thrown out this morning. We were thrown a challenge to meet new people at coffee break. Well, I am going to throw a bigger challenge. We have agriculture people on the Prairie Habitat Joint Venture Board and on all of the provincial boards and committees. Maybe it is time that we have more wildlife representation in some of the other federal-provincial agriculture programs. We talk about it all the time, why not do it? Why not allow some of the cost sharing participation of some of our program and some of the federal-provincial accords. Certainly, I think this would open the minds as well as the pocket book for a number of initiatives. We have precedents, the province and Agriculture Canada currently cost share waterfowl compensation programs across the prairies. Why not cost share some of the initiatives in on farm conservation planning and other things which are really close to your hearts? I think it would be a good opportunity and a good initiative where we could all benefit.

Well, time is getting on and I want to conclude with just a few thoughts. I think that there are some fundamental principles that we want to keep in mind as we discharge our duties in conservation planning. We need to develop sound plans and proposals. We have to know what we want to achieve. People have to know what we stand for and how they might relate to us and whether there are common interests that should be brought together. We can't do this if we keep our light under the basket all of the time. I think we must look outward and consider all the other interests involved, but not inward. It is too easy sometimes to look inward for security, where management systems and authorities are in place. I think we have to extend ourselves outward even though it may be hard. We must never lose sight of some of the ecological principles at work, particularly, if we ever hope to strive for anything like sustained productivity in ecosystems. We have to recognize these basic principles in our planning. We must involve some of these other interests and disciplines and the public in the early stages of our planning and not after the fact when we seem to be polarized and end up across firing lines again. And finally, I think we must strive to fulfill the expectations of the environmentally aware public and manage our soil, water and wildlife resources in a manner to ensure that we have diverse and productive ecosystems around for generations yet to come.

WHAT DO YOU NEED FOR A FARM CONSERVATION PLAN?

by
Tom W. Goddard
Alberta Agriculture

I would like to present seven points I think are important for a farm plan. I will start with the assumption that appropriately trained professionals and technical staff are available to do the planning. Conservation planning requires technical competence across a range of disciplines as well as good people skills. Investment in training (and planning) is nearly always needed before embarking upon a farm conservation planning initiative.

1. **Farmer's needs and concerns.** The farmer(s) must be consulted early in the process to determine the farmer's needs and concerns. Farm conservation planning is easier and more successful if it addresses all of the farmer's needs and wants. If farm planning is done to deliver a program or reflect a government department's concerns and if a farmer does not share them or if the farmer has additional concerns then the planning exercise will not be successful. Farm planning does not need to address all needs or solve all problems but it should acknowledge that they exist and provide links to as many as possible.

2. **Aerial photography.** The most appealing component of farm planning to farmers are air photos of their farm. Alberta farmers can contact a central office for a computer search to provide coverage dates and film type for their land location. Contact prints and enlargements are ordered from the same office. Current and historical photos can be compared for temporal analysis of the land and water resources. Farmers can easily grasp photo interpretation techniques. Air photos serve to illustrate and thus enhance discussions between the farmer and planner without having to repeatedly travel to all corners of the farm.

3. **Landscape information.** Other readily available resource information includes soil surveys, general land assessment, hydrogeologic and surficial geology maps. All these sources are in need of interpretation for use in a farm conservation plan. With a wide variation in both the level of scale and detail of information the interpretation needed varies from source to source. In Alberta, land assessment contains the most detailed information on a parcel of land. There is potential to interpret the physical land data in the assessment for conservation planning purposes.

4. **Mapping overlays.** Farm conservation planning should look at the various combinations of resource and management information to arrive at an understanding of the whole system. We have found farmers are attracted to the idea of plastic overlays on air photos for layering information and even for keeping records. This is the beginning of integrated or "whole farm" planning.

5. **Integrated information.** Government, universities and research stations are structured by scientific discipline and thus nearly all of the products from those institutions are delivered on a discipline basis and often only deal with a field of study within a discipline. Farmers on the other hand are in the business of farming and therefore must integrate information from all

disciplines to their farm level. There is very little to nothing out there to help them in that process. Conservation planning should structure information in an integrated fashion and integrated products should be developed.

6. **Alternatives.** A farm conservation plan needs an analysis of the problems on the farm and suggested alternatives to the current resource management practices. Preferably several alternatives are available for each problem/concern. Some may be cheaper and quicker to implement than others. Some may not make sense now but will if conditions change in the future. Farmers do not want to be told there is only one option.

7. **Forms.** Administrative forms are needed when farm conservation planning involves incentive or compliance programs. Care should be taken to prevent any perception that farm planning is a government bureaucracy exercise rather than a farm management tool. Nevertheless farm planning is an excellent method to deliver incentive programs. Keep conservation planning as a primary objective not program delivery. Farm planning should also not be overlooked as a medium to deliver or promote other production, economic or conservation related programs.

The following are NOT NEEDED to do farm conservation planning:

Programs (government incentive or compliance programs)
Large scale conservation plans (municipal, regional, provincial levels)
Computer systems and erosion models (expert/interpretive programs)

They can, in the case of the last two, make farm planning efforts more targeted, provide more information or speed up the planning but are not essential to farm planning. There is a danger that they can also make the process more complex and open to errors in interpretation, bias the emphasis of the information or analysis of it, and increase the "fog" level for the farmer.

WHAT DO YOU NEED FOR A FARM CONSERVATION PLAN?

by
P.J. Barlott
Barlott Consulting Ltd.
and
Pedocan Land Evaluation Ltd.

This brief statement on farm conservation planning is based on our current experience in farm conservation planning in southeastern Alberta involving over 60 farms and 700 quarter sections of land. This on-farm planning effort is being carried out under the 1990 Southeastern Alberta Disaster Assistance Program.

I will highlight what I believe are the key steps in farm conservation planning as well as what I believe are the most important things to include in a conservation plan. We are usually only involved at the very early stages of the conservation planning process with the farm manager and therefore tailor our approach to providing the farm manager with the information needed for subsequent decision making. The conservation plan is one approach available to help the farmer make choices and decisions; in this case decisions that will impact the long-term sustainability of his/her farming operation.

While the complete planning process involves many steps from initiation and information gathering to decision making, monitoring, evaluation and plan update; I would like to stress five steps that we concentrate on in developing a conservation plan for farm managers.

1. **Data Gathering and Interpretation at the Farm Scale.**

   We use existing information sources and farm-scale mapping to prepare a preliminary inventory of the land resources specific to the farm. Soil survey maps and reports, municipal assessment field sheets and other sources such as satellite images and irrigability classification reports are considered along with air photo interpretation. We develop a preliminary inventory of the land resources on the farm in the form of three maps - one showing land use, the second showing soil and landscape features, and the third identifying problem areas. Farm conservation planning must be relevant to the resources on the farm; therefore, the inventory must be site specific.

2. **Initial Farm Visit.**

   A farm visit is then carried out to gather additional information and identify the farm manager's goals, objectives and priorities. This is an important step wherein the farmer verifies the preliminary information documented on land use, soils and landscape features, and problem areas. Additional information on cropping, tillage and other farming practices is collected. Key problem areas from the farmer's perspective are identified as well as the farmer's primary soil and water conservation objectives. Ideally field truthing would be carried out at this stage; however, we rarely carry out any field truthing not having the time nor finances available to collect, analyze and report on the more detailed and comprehensive information.

3. **Identification of the Problem Areas.**

Following the farm visit all information is assessed and interpreted with refinements being made to the land use map and the soil landscape map along with their associated tabular descriptions. The problem area map is then finalized to identify the location, extent and severity of the major soil and water conservation problems. Potential risk of such problems as erosion and salinity and actual existing problems and "focal points" are identified and mapped.

4. **Development of Viable Alternative Solutions.**

Using the three maps and associated tabular inventory of land use, soil landscapes and problem areas, priority target areas are identified and alternative solutions are developed for each area. Alternative solutions are presented by field, soil type and landscape class. Conservation checklists showing available conservation solutions for various problems are used to key in on priority alternative solutions. A fourth map showing specific solutions and various alternatives available is then developed.

5. **Farm Visit - Plan Presentation.**

Another farm visit is made to discuss the farm plan with the farmer. The plan is a working document used with the farmer to discuss his conservation priorities and the alternatives available to him. This visit provides clarification of the information presented in the plan and serves as the first step in decision making, priority setting and the development of an action plan for implementing conservation practices. This is the start of an important decision making and action planning process, a process that is perhaps more important than the conservation plan itself. Ideally, the farmer will incorporate this information into his entire farm management planning process.

We believe there are several key elements to a farm conservation plan:

1. **Visual Presentation of Farm Scale Information.**

The conservation plan should present site specific information in maps, tables and diagrams. The primary focus of the plan we leave with a farmer is presented in four farm-scale maps (at a scale of 1:10,000) each in the form of an air photo mosaic: Map 1. Present Land Use; Map 2. Soil Landscapes; Map 3. Problem Areas; and, Map 4. Alternative Solutions. An air photo enlargement of the farm also is left with the farmer along with overlay materials appropriately labelled for use in further planning and record keeping.

2. **Keep It Simple.**

A very large amount of information is often gathered in the process of developing the plan. The tendency is to include everything in the report. While it is important to document and include key information in the plan, a short summary presentation of key information will have the greatest impact. As noted previously, the conservation plans that we prepare for farmers concentrate on a presentation in the form of maps and air photo mosaics.

Information that accompanies the maps is presented in tabular format or in the form of checklists as much as possible. Brief summary paragraphs are included as explanation of key items for follow-up review by the farm manager. Additional references, work sheets and fact sheets are included in appendices. The local agricultural fieldman, soil conservation officer and district agriculturist provide follow-up advice and information.

3. **One-on-One Discussion with the Farm Manager.**

Two farm visits are carried out with the farm manager. This one-on-one approach in identifying the farmer's problems, objectives and alternative solutions is important. The planning process carried out with the farmer is perhaps more important than the plan itself and should concentrate on the farmer's priorities. Rather than trying to explain everything to the farmer, it is best to concentrate on the one or two priority areas identified through joint discussions and decisions with the farm manager.

One area where we believe the approach used in farm conservation planning is currently lacking is in the area of the economics of conservation production systems. While conserving the soil resource is a focus of the conservation plan, the farmers must also sustain the economic viability of their farm operations. A cost comparison of all the alternative solutions presented in a plan is not available. Cost:benefit comparisons of the alternative solutions should be presented for the particular farmer's situation and farming practices. We recognize that this would require a considerable amount of time and effort, but cost:benefit studies and comparisons for specific soil types, climatic conditions and farming practices are required.

WHAT DO YOU NEED FOR A FARM CONSERVATION PLAN?

by
Rick Van Kleeck
B.C. Ministry of Agriculture, Fisheries and Food

Farm conservation issues can be divided into two main areas, soil and/or water conservation. Soil conservation issues can be further subdivided into items such as: erosion (wind or water), productivity (acidification, compaction, nutrients, organic matter decline), and organic soil subsidence. Water conservation issues include efficiency of use and water quality.

British Columbia has nine strategies to address soil and water environmental concerns. They are: Code of Agricultural Practice for Waste Management, Agricultural Environmental Guidelines, Agricultural Environmental Protection Council, Best Agriculture Waste Management Plans, Best Soil Management Plans, Agricultural Land Development Assistance Program, Canada-B.C. Soil Conservation Program, Nitrogen Behavior Simulation Computer Model, and investigation into alternative uses for manure utilizing waste treatment systems.

Best Agricultural Waste Management Plans are farm conservation plans designed to address water quality issues caused by agricultural wastes, and the maintenance of soil productivity through the correct use of manures. An explanation of Best Agricultural Waste Management Plans follows.

BEST AGRICULTURAL WASTE MANAGEMENT PLANS

Best Agricultural Waste Management Plans provide waste management recommendations for producers who have pollution concerns caused by:

- livestock manure (collection, storage or spreading),
- dead animals (disposal),
- livestock feed waste
- silage effluent
- yard runoff (clean water running into livestock yards, or manure running out of yards),
- dairy milk house waste
- greenhouse waste water.

Best Agricultural Waste Management Plans are not intended to address pesticide pollution concerns.

Producers should contact their local agricultural office and discuss with the District Agriculturist the need for a Best Agricultural Waste Management Plan. If a plan is required, a work request identifying the farm and problem is sent to the Soils and Engineering Branch. An engineering specialist will visit the farm with the producer and jointly develop the Best Agricultural Waste Management Plan to address the identified or potential pollution problems.

The plan will consist of a written description of the: (1) present situation, (2) possible pollution problems, (3) suggestions for improvement. The Plan will include sketches if appropriate. The suggestions are grouped into three areas: (A) very important, (B) important, and (C) should be considered. The plan will also indicate works which require a professional engineer design.

When all the suggestions in the Best Agricultural Waste Management Plan are followed the producer's operation should be in compliance with all provincial and federal environmental laws and regulations including the Code of Agricultural Practice for Waste Management.

ITEMS NEEDED FOR A FARM CONSERVATION PLAN

From working with Best Agricultural Waste Management Plans the following steps were found to be crucial.

1. Inventory: - determine existing facilities and management practices
2. Evaluation: - meets Federal and Provincial environmental requirements
   - environmetally sustainable
3. Solutions: - resolve any environmental concerns
   - tailored to individual farmers short and long term plans
4. Priorities: - set order of importance that solutions should be implemented
5. Assistance: - indicate when required and where to get financial and technical assistance

WHAT DO YOU NEED FOR A FARM CONSERVATION PLAN?

Conservation Planning in Southwest Saskatchewan

by
Paula Brand
Prairie Farm Rehabilitation Administration

A brief background on the southwest experience:

District #11 (an area of 7 rural municipalities bordering on the South Saskatchewan River & the Alberta border) were not happy with the current on farm soil conservation program commonly called Save Our Soils Program (SOS). As a result of wanting something "new & different", the local committee requested via the SOS steering committee, on farm conservation planning be initiated in their district. This all began in January of 1990.

The process started with the collection of information. The Saskatchewan Institute of Pedology supplied wind and water erosion and salinity maps of the district. These were used to target areas for the workshops. Aerial photographs and satellite photos with wind erosion overlays were also obtained.

Group planning sessions were initiated in the district in the winter of 1991. The local producers on the ADD Board (similar to an Ag Service Board) were required to get involved. They set up the group meetings. They decided on dates, locations and most importantly, the participants.

All meetings (7 in all, one in each municipality) had the same format. It began with a discussion of soils information, reading soils maps and aerial photographs. A discussion with the producers about their current conservation practices and ideas followed. The CanHelp model (wind & water erosion equation model) was demonstrated. The model compares the effect of different rotations and practices on wind & water erosion. The model was used to show relative changes in soil losses rather than dealing with absolute numbers.

At the end of the meeting, all producers were given a worksheet to complete about their cropping practices. If they were interested in getting more specific about their sites, they were asked to complete the worksheet and send it back to the PFRA office. From this worksheet and subsequent conversations with the producer, a conservation plan was put together. Approximately 35 producers attended the workshops and about half the worksheets were returned as requests for individual plans.

The entire process was generally well received by producers. The SOS technician (Dale Fyke) provided some follow through with the plans. He was instrumental in getting many of the field projects started.

WHAT DO YOU NEED FOR A FARM CONSERVATION PLAN?

Local involvement - The entire process must be demand driven.

There is a strong need for production economics tied to conservation.
Always hit with that's nice but......($)

Include all aspects of conservation and production. Not just soil conservation anymore.

but only to the extent producers are interested.

Aerial photos & Soils Information

These items were always well received.

Listen - must have an opportunity for producers to "present" ideas.

They learn from each other and ultimately write their own plan.

It is important to remember - The group setting & process is just as important as any plan written.

The group setting or planning process is an important avenue to provide technical information so producers can make educated decisions.

It is important to provide good solid technical information but in producer-friendly terminology.

There is a reluctance to write out plans. They need to be kept simple and achievable.

Must realize that everything cannot be accomplished in the short-term, therefore set realistic expectations.

FARM CONSERVATION PLANNING
Panel Discussion Questions and Answers

Moderator: Jim MacQuarrie, CBC-TV Edmonton

NOTE: The alloted time during the Panel Discussion did not permit answers to all of the following questions. Answers to the questions were provided by the panel members at the request of the editors.

1a. **Q** At what point in the planning process do habitat concerns (ie. waterfowl / wildlife) get addressed?

A Paul Barlott - Habitat concerns are addressed whenever water management is a priority for the farmer. All water management projects consider the impacts on wildlife/waterfowl habitat in the feasiblity and impact assessment. Habitat concerns also are indirectly addressed in all soil conservation plans. Every conservation plan usually includes recommendations for residue management, conservation tillage, cropping alternatives and/or permanent cover. These conservation alternatives maintain and enhance waterfowl/wildlife habitat.

A Tom Goddard - At present we don't directly address habitat concerns other than to ask the farmer if they have preferences for wildlife habitat and point out that conservation practices such as shelterbelts and forages may have additional benefits for wildlife. We need some sort of habitat criteria and wildlife checklists that can be used by the non-wildlife biologists for planning purposes.

1b. **Q** Are experts in these fields part of the process?

A Paul Barlott - Soil and water conservation experts are involved in all conservation planning projects. They have a good understanding of waterfowl/wildlife concerns and consider the multiple land uses and the impacts of farming practices on the land. Waterfowl/wildlife experts from such groups as Ducks Unlimited and the Fish and Wildlife Division of Forestry, Lands and Wildlife are brought in when their input or assessment is required.

A Tom Goddard - To date we haven't involved them other than referring farmers to their local wildlife officer for assistance in developing habitat.

2. **Q** Tom: How do you integrate the components of the plan and evaluate/assess the relative effectiveness of the alternative solutions you provide the farmer?

A Tom Goddard - Components are integrated by the fact that they are all contained within the same document and referred to one another. Within an individual component such as inventory, we try to inventory all resources (ie., more than soils). The relative effectiveness of the alternative solutions is determined by the planner with consideration to the particular farming system and type of resources and in consultation with the farmer. Physical record sheets are included with the plan and evaluation procedures are discussed with the farmers.

3. **Q** Paul: You spoke specifically of individual farm plans - one on one. What are the average costs and time requirements per plan?

A Paul Barlott - The average costs of a farm plan range from $2.00 to $5.00 per acre requiring about 5 to 8 man-days of professional and technical input per plan. The costs depend on the complexity of the soil/landscapes, the requirements and priorities of the farmer, the availability of the data and the land area (size of farm) included in the plan. Farm conservation plans for one section of land or less (i.e., 640 acres or less) would tend to be in the upper cost range while conservation plans for relatively large farms (e.g., 3 sections of land or more) would be in the lower cost range. Conservation plans for very large farm land areas could be prepared for less than $2.00 per acre.

4a. **Q** How much of the plan was carried out by the producers? How much of the plan needs to be carried out to be "successful"?

A Paul Barlott - Producers are involved early in the planning process to provide their input and information on land use, farming practices, conservation concerns and priority areas. The plan is prepared to meet the farmer's priority conservation objectives. The farmer is also a key player during the presentation of the plan during which time the initial steps are taken in developing an action plan. The producer is a key part of the process.

"Success" can be measured many ways. In my opinion even a small change is positive. Several small changes over time will make a significant impact. Good communication and exchange of ideas and information at a farm visit is often a "successful" result. Positive reactions, acceptance and involvement are often signs of success.

A Tom Goddard - Hopefully the producer will carry out 100% of the plan. If you are referring to the percentage of the planning time that the producer is involved in it would vary depending if the producer was involved in one on one planning or group planning. It could be less than 10% of the planning time in a one-on-one situation to as much as 80% of the time in a group planning situation. As long as the producer is involved in the planning process to a level he is comfortable with, the plan should achieve some degree of success.

4b. **Q** Is follow-up necessary?

A Paul Barlott - Follow-up should be a part of the planning process. The local agricultural fieldman/soil conservation officer and the district agriculturist do carry out follow-up visits. Evaluation of the planning process should also be a built-in part of the process to assess strengths and weaknesses for ongoing adjustments and improvements.

A Tom Goddard - Yes, especially with group planning.

5. **Q** Tom: How would you tackle farm planning for 70,000 farmers?

A Tom Goddard - Very slowly! Assuming none of the provinces have sufficient field staff to visit with that many farmers on either a one-on-one or group basis, planning would have to be a very brief, do-it-yourself type of exercise. I would suggest a short workbook as well as incorporating conservation planning principles into other aspects of extension delivery systems. Before tackling that many farmers I would ask the conservation planning philosophy to be adopted, such as, is it used to delivery a compliance or incentive program, or is it to serve as an integrator of production technology disciplines? Then I would examine the client base and focus on target groups such as those that have highly fragile resources or those that would benefit from a particular program the most.

6. **Q** What has been the net physical effect (positive?) of the soil conservation planning done to date?

A Tom Goddard - Soil degradation has been reduced. Farmers have been very interested in their conservation plan and the alternatives suggested. Our recent survey has indicated that most of the farms have implemented some of the agronomic and soil degradation controls. We have not quantified affects using erosion equations because:

1. We often don't have the data to drive the erosion models;
2. Applying the models to all prairie soils often stretches them beyond their limits;
3. Using the wind and water erosion equations tends to focus planning only on those aspects.
4. There are no models for salinity, organic matter, etc.
5. Often practices not accounted for in the models will reduce erosion to the same extent (fertilizer/herbicide management, livestock management).

7. **Q** Paul: I agree that producer's economics is a badly neglected element. To fully address this we have to show producers how the economics of their best and poorest land compare. Can formulas based on soil types, field practices, commodity prices and input costs achieve this? If not how can we address this?

A Paul Barlott - Yes "formulas" that consider soil types, landscape, climate, field practices, management practices, commodity prices and input costs could provide the required results; however, the data from studies and research projects that consider all the variables and factors are currently lacking. Field scale data collection is needed (e.g., soils, nutrient levels, yield mapping, cultural practices, etc.). The challenge is to start closing these data and information gaps. This is no small task.

8a. **Q** Should licenses to withdraw water for domestic, livestock and irrigation require the applicant to prepare and submit an on farm water management and conservation plan or strategy as a license requirement?

A Tom Goddard - I don't think an entire conservation plan is needed but a water management plan would likely be helpful for all parties concerned.

8b. **Q** Should water use on farms be metered?

9. **Q** There appears to be a tremendous dirth of economic information with respect to conservation practices vis a vis conventional farming

practices. This lack of information appears to be prairie wide. Is there an opportunity for the three provinces to unite their resources and fast track the development of this information by soil texture, climatic zone, etc?

A Paul Barlott - A multidisciplinary, multi-agency, multi-province effort would be nice to see. Perhaps there is an opportunity to see some of this happen through the agreements and programs being carried out under the federal/provincial initiatives under the Green Plan.

A Tom Goddard - This is my question too! Let's ask our bosses. I think there is a general willingness or desire to work together but sometimes our institution structures do not facilitate that as well as not having a mandate to work together for task oriented or problem solving exercises. I believe all conservation recommendations should be stratified by general soil/climatic area.

10. **Q** Do you think 4H farm conservation clubs would be feasible and would stimulate conservation thinking?

11. **Q** Implementation of the farm plan. A farm conservation plan is of little importance unless it effectively implemented. Could the panel address this question if it is a problem and how it has been resolved.

A Paul Barlott - A partial answer to this question is found in my response to question 4a regarding "success". "Successful" or effective implementation of the plan can be achieved in small changes. Several small changes over time will make a significant impact. Where large changes are being considered (e.g., change in tillage or seeding equipment), considerable care and caution must be taken. The producer must consider many factors when he makes his final decision, which he alone must make, considering all the information and using as many decision support systems as he may have available. We have no method for requiring adoption. We rely on the normal technology transfer and adoption process to result in the implementation of the farm plan.

A Tom Goddard - In Alberta we have no compliance program that requires plan implementation. Neither do we have financial incentives to develop and implement a conservation plan. Conservation planning must be sold on its own merits of good farm and physical resource management. If a conservation plan makes sense with desirable end results and is achievable then likely the farmer will implement part or all of the plan. Implementation of a plan usually takes more than a year because some aspects may be implemented immediately while others are more long term. Does implementation of part of a conservation plan constitute success or failure of the plan?

12. **Q** A lot of the problems of soil conservation are caused by what has happened in the past. Why does the history of the farm appear to be such a small portion of the plan?

A Paul Barlott - The history of the farm is a relatively large part of the plan. In our plans we prepare an inventory and maps of current land use, soil landscapes and soil problem areas. Current and historic practices also are documented and successful and unsuccessful past practices are reviewed with the farmer. These layers of information and maps give a good picture of the history of the farm.

A Tom Goddard - I don't know that history is such a small portion of the plan. We try to document historical occurences if and where they are important. A lot of the discussions with the farmer in developing the plan encompass the historical aspects of resource management on the farm. We try to emphasize analysis of the current practices (which already could be superior to historical practices) and assess their impact on the soil and water resources currently and in the future.

13a. **Q** Paul: What percentage of farmers you work with adopt your recommendations?

A Paul Barlott - We do not have statistics or information on the rate of adoption of our recommendations. We do, however, get a fairly good idea of which farmers will probably take some action versus those that will not during our second visit when we present the plan and discuss an action plan with the producer. There have been a number of cases where the producer had already taken some action contained in the plan as a result of our first visit as we inevitably get into conservation alternatives with the farmer even in our first data gathering visit. However, even small changes can be considered a "success" as noted in responses to question 4a and 11.

13b. **Q** Do you do a follow-up on each farmer and evaluate the plan?

A Paul Barlott - We do not do a follow-up on the plan or evaluate the plan at present unless we are called back to do so by the farmer or by another funding agency to do so. Follow-up is currently carried out in most cases by the local agricultural fieldman/soil conservation officer or district agriculturist. The local agricultural fieldman or district agriculturist are regularly involved in both farm visits we make with each farmer in the planning process; therefore, they are in a good position to carry out the required follow-up.

14a. **Q** Tom: Can producers afford to pay the direct costs of developing farm plans through the use of private sector consultants?

A Tom Goddard - That would be better asked of a cross-section of producers. Some probably can and others can't. Consultant farm plans can cost less than one cultivation pass on an acre basis. Can a producer afford to forego one cultivation for one year?

b. **Q** Where should the government involvement in farm planning end, investment-wise?

A Tom Goddard - I believe that government should be involved in funding the development costs for conservation planning materials and methodology. Governments themselves have to ask to what extent do they direct their existing field staff to become involved in conservation planning, to what extent do they hire new staff specifically for conservation planning, and to what extent do they fund consultants to provide that extension service.

If responsible care of farmland is deemed to be in the public interest then public funding should be provided.

15. **Q** Paul: Under the Disaster Assistance program, what are the incentives for the farmers to implement the plans you prepare for them?

A Paul Barlott - The incentive is the data and the information contained in the plan and the transfer of information during the farm visits with the producer. The more the farmer is involved in the process the more ownership he has and the more incentive he has to implement the plan. The farmer receives information that is targeted to his problems, to his situation and to his site specific needs which will result in better decision making. The result of better decisions will produce both short-term and long-term dividends and benefits to his farming business.

16. **Q** Paul: What steps need to be taken to provide farmers with the economic information related to farm planning that is needed for decision making?

A Paul Barlott - The first step is a need to fill the information and data gaps that currently exist. The response to this question is partially found in my response to question 7. Studies are required to assess the many factors including soil type, landscape, climate, nutrient levels, field practices, equipment used, management practices, yields, commodity prices and input costs. In some cases new studies may not be required. Cost/benefit assessments can often be made using current research results as long as the required field scale data and variables have been monitored and collected. General averages and broad regional or provincial results will be of limited value to the farmer. The farmer must see that the information is specific to his problems and alternative solutions and to his site specific situation and needs.

17. **Q** Were wildlife management people involved in any of your farm planning sessions? Also, farm economists?

A Tom Goddard - See question 1 regarding wildlife. Farm economists have not been directly involved in conservation planning to date. Economic analysis of conservation systems needs to be assembled and analyzed (see question 9). We emphasize the need for physical record keeping and evaluation, both short and long term, of a change in farming practice. We provide several forms of farm physical record sheets and some partial budget templates. We find the physical record sheets nearly as popular as the aerial photographs. Recently, a group of DA's in Alberta recognized the need for physical records and developed a record keeping package that farmers could take and modify for their own use. Contact Neil Miller, DA at Lacombe for further information on that package.

18. **Q** Gov't Rep's on Panel: (4 part question) How many plans are done yearly?
How many staff members are required to do these plans?
What is the cost to the taxpayer for each plan?
Have you done an environmental cost/benefit analysis to determine whether the taxpayer is getting "bang for their buck"? If so, what were the results?

A Tom Goddard - Since March of 1990, we have done approximately 140 farm plans not including those done by consultants. Remember we are still going through a start up period and nearly all farmers and most extension staff are not aware of what a conservation plan is. One staff member is required to do a conservation plan when one-on-one planning is done. Three district staff members have been present at group planning workshops. We haven't calculated taxpayer costs per plan. I am not aware of any Canadian agriculture extension studies that have costed out services. Could you please inform me if you are aware of such studies? Just looking at staff costs and ignoring overhead it could be a couple of hundred to a few thousand dollars depending on the form of planning used, size and complexity of the farm and the number of staff and departments involved. Environmental cost/benefit analysis have not been conducted. We are tabulating a questionnaire survey at present. You can contact me in mid-to-late 1992 for the report on that.

I also plan to evaluate the conservation planning done by all four consultant companies we have hired. This will be done in 1992-93 by ourselves and the farmers who received plans.

19a. **Q** Paul (& or others): In your presentation you noted the importance of having economic cost/benefit information on the different conservation alternatives identified while preparing a farm plan. How would you propose we come up with reliable cost benefit figure of value specific to a particular farm with unique soil types, micro climates, cropping history, equity ratios, equipment availability, etc?

A Paul Barlott - This question is very similar to question 16. The first step may not involve new studies, but rather may consider existing long-term research results that have monitored and collected the required data and by performing the required cost/benefit assessments. The cost/benefit data must be specific to the site specific needs and problems on individual farms. If new studies are required, several pilot study areas should be carefully selected and monitored to collect the required data. A multidisciplinary, multi-agency and multi-province effort would be useful (see question 9).

19b. **Q** Are there existing resources &/or information that can be used?

A Paul Barlott - Yes, as referred to in my response in question 19a.

19c. **Q** Is there a need to do more work in this area? What? By whom?

A Paul Barlott - Yes, there will more than likely be a need for more work. A pilot study approach targeting selected sites for monitoring and data collection would be useful as noted in my response to question 19a.

20. **Q** Do you think conservation planning will join with crop planning, farm financial planning & other plans to create an overall farm management plan?

A Paul Barlott - Yes this would be nice to see and of most use to the farmer. An integrated sustainable approach will be required. Such an approach must consider conservation planning, financial planning, crop planning, and all aspects of strategic and operational planning for the farm. An integrated approach would be a most challenging task.

A Tom Goddard - Yes, I hope so. I like to think of a conservation plan as a "physical resources management plan" that outlines the production potentials on the farm which then feed into a financial management plan. The resource management plan should both feed into and reflect the farm business/family goals.

21. **Q** Paul: How do you ensure that activities outlined in a farm plan are carried out?

A Paul Barlott - This question and the response are similar to question 11. Followup and ongoing support from the agricultural fieldman/soil conservation officer and the district agriculturist are important elements.

22. **Q** A few producers are now farming by landscapes in areas where different management strategies are appropriate. This often means significant changes in size and shape of fields. Is this farming system a viable alternative in farm conservation plans?

A Paul Barlott - I believe farming by soil type or by landscape type are conservation farming approaches not widely practised at present that have significant conservation potential with very positive cost/benefit results. We have been introducing these concepts into the farm conservation plans we prepare whenever feasible. It might mean major changes in field size and shape in some cases. However, conservation farming approaches such as residue management, conservation tillage and contour farming then can be uniformly applied on each field.

A Tom Goddard - Yes. I have run across a few of these producers and they have found farming by soil type is very beneficial. The farming practices within each soil type are nothing out of the ordinary. The biggest hurdle is probably accepting that field borders are not linear and corners are not at right angles. Farming by soil type is the most cost effective method so it is usually fairly easy to sell. A spin off benefit here is that often the field delineations reduce the farmland assessment and thus taxes. The problem becomes where soil types change very quickly over small areas such as solonetzic soil. How small an area can be delineated before it compromises farming operations.

23. **Q** What should be the role(s) of the private sector consultants in conservation planning?

A Paul Barlott - Private sector consultants play a key role in the planning process, being an integral part of the multidisciplinary and multi-agency effort required. The private sector is in a good position to be able to allocate the resources and time required to prepare the plans and to consult with the farmers on an on-going basis. An issue, however, will be the level of similar services provided by government agencies (federal, provincial, and municipal) as well as producer groups funded by government. It will be difficult for the private sector to compete with free or highly subsidized services. The privatization of extension services and technology transfer is coming in some countries such as the United Kingdom that is currently run as a crown corporation with farmers paying for services on a cost recovery basis. I believe the same changes will occur world wide over time. Agriculture is part of a global economy. Many farmers in the prairie provinces favour less government involvement in agriculture and would be prepared to pay for services. A number of major policy issues do, however, need to be addressed.

A Tom Goddard - Wherever they are qualified and wherever you want to use them. We have used them very satisfactorily in implementing disaster assistance programs. The conservation planning there emphasizes planning to eliminate or at least minimize the impact of future damage (e.g. gully erosion or siltation caused by extreme rainfall and flooding conditions). I would also consider using consultants to develop example or prototype farm conservation plans where it is a new initiative. A municipal or provincial government may utilize consultants to develop farm plans for a specific targetted group or area such as an extremely wind erosion prone area. Where other staff are not available or the project is short term, consultants can be used to do the work or, work with and/or help train field staff. Consultants can also adopt integrated conservation planning or resource planning in industries other than agriculture such as the petroleum or mining industries.

24. **Q** Tom: If you were going to introduce "On Farm Conservation Planning" to a new area unaware of this idea, then what methods would you use to do this? By letter? By public meeting?

A Tom Goddard - First I would probably dust off an extension or marketing text! I would consider targeting conservation planning to a geographic area of importance or a particular client type. Assuming there would be no incentive or compliance program that would direct a marketing campaign I would then look at the clientel I want to sell conservation planning to, the issues of importance in agriculture today in that area, and then look at how conservation planning can be used to eleviate or manage those issues. I would then design my publicity around those issues and the other benefits of conservation planning utilizing more than one type of media and mode of publicity. This would likely include a flyer drop to selected postal codes, inclusion in other extension newsletters and newspaper columns, a radio ad for conservation planning and notice of an upcoming meeting, a public meeting specifically for conservation planning or a five to ten minute conservation planning sales talk at other agriculture extension meetings.

25. **Q** As farm conservation planning assistants, do you feel you have information on wildlife - related programs to give farmers some assistance in taking a more holistic/multi-resource approach to planning than they may have taken in the past? If not, how could we improve this situation?

A Paul Barlott - An integrated agricultural, wildlife, multi-resource approach would be useful. While this approach is used as much as possible (e.g., see response to question 1); there is a need for a more integrated and cooperative approach. Perhaps one way to have this happen would be through a pilot project approach which would specifically use a multi-resource approach in farm planning. Such a pilot project approach could include preparation of information (fact sheets, databases, etc.) using this approach as well.

A Tom Goddard - We have limited information on wildlife, wildlife programs and wildlife habitat. In Alberta the main materials I have are wildlife and fish farming factsheets which I provide if the farmer is interested. I also have a couple brochures on wildlife programs however, these brochures are rather vague as to the area of emphasis of the program and criteria used to evaluate an applicant. It seems that a wildlife specialist is needed from the beginning for those programs. One source I recently came across that I plan on using in future conservation planning is the SCS Plant Materials Handbook for Montana which includes a section on wildlife habitat descriptions for a wide range of wildlife species. This describes what desirable habitat looks like and then we can determine whether or not that habitat exists on a farm or could exist if certain developments were undertaken. We need to sit down with wildlife biologists and develop some simple criteria and planning aids to incorporate wildlife considerations into a first cut conservation plan. A wildlife specialist would become involved where detailed planning is desired for wildlife. We need planning materials for the non-wildlife biologist and farmer.

26. **Q** How do you sell conservation planning in the present economic climate?

A Paul Barlott - Conservation planning can pay for itself. Conservation alternatives are often very cost effective, in fact, the adoption of some conservation farming practices is due to the cost savings or financial benefits. As well the cost of a farm plan ($2.00 to $5.00 per acre - see question 3) is less than or equal to the cost of one field cultivation operation. (See response to question 15 for additional information to supplement this response.)

A Tom Goddard - A conservation plan is a good management tool regardless of the economic climate. Conservation planning can show how to optimize the use of fertilizers, herbicides and equipment which all have economic implications. The physical record sheets are promoted along with encouragement to evaluate current and alternative farming practices both in the sense of protection of the resource and economics. Conservation plans show the inherent problems and productivity of the soil landscapes on a farm and how to best preserve and utilize those landscapes (it costs more to make a soil do something it isn't inherently capable of).

27. **Q** Tom: Conservation measures pay long term benefits at short term cost. Most of our farmers are in desperate need of short term solutions. How can you expect to sell conservation measures to these producers without incentives or compliance monitoring?

A Tom Goddard - I don't try to sell conservation planning as a short term solution. Some very good short term solutions may fall out of the planning process but the process is done for the long term conservation and production on the farm. Perhaps more involvement in long term planning would prevent farms from falling into crisis situations. I would suggest that some incentive and compliance programs exacerbate short term crisis as they are relatively short term programs themselves. Producers would like to minimize government involvement in their farming operation so perhaps government programs should not direct the reasoning for farmers to adopt conservation planning.

28. **Q** Tom: You indicate that you don't need incentives to do on farm planning. Why, as a producer, would I be at all interested if there is no incentives to spend time developing a plan?

A Tom Goddard - As a producer if you are interested in learning more about your physical resources on your farm the impact of your current farming system on those resources and a list of ideas and alternatives that could be incorporated over either the short or long term to increase conservation, productivity and hopefully decrease costs then you should be interested in developing a conservation plan. A conservation plan should be looked at as a tool for good farm management.

A Paul Barlott - See responses to questions 15 and 26.

THE MANTLE OF SOIL CONSERVATION

by
Don Gayton, P.Ag.

I came by a fascination for soils and their conservation by way of a curious journey. That journey started in the central Andes of South America. The farmers, or campesinos I worked with there had no access to the level and fertile valley bottoms, where wealthy absentee landlords pastured their thoroughbred horses behind white picket fences. If these campesinos wanted to farm, they did it by squatting on precipitous side hills that were far from the main valleys. To actually clear the land was foolhardy, so they merely removed the larger trees and planted right into the slash.

The planting prescription in those Andean valleys was very simple; it was "paso y picazo," or in other words, take a long step and then swing your mattock, to open a hole where you planted corn and pole beans together. If you were fortunate, a dead fish from a nearby river went into the hole along with the seed. Then you took another long step, swung your mattock and that was how you planted your miserable half-acre hillside. If you were lucky and the rains weren't too heavy, the hillside would hold and you would get a crop. If it didn't, you went to work on a coffee plantation or moved to the slums of Bogota.

Then I moved back to North America, to the opposite end of the cultural and geographical spectrum, to the incredible loess hillsides of the Palouse country around Washington State University. There I was instructed in the fundamentals of soil science, and in my spare time, I had a job sampling the local creeks for a water quality laboratory.

The Palouse country, for those of you who haven't seen it, is a continuous series of steep, wind deposited hills with some of the deepest soil profiles in the world; eight, ten, even fifteen feet of fine silt loam with stones, if you could find them at all, no bigger than pea gravel. The Palouse hills are a geological accident, a miraculous fluke of wind deposition, that has been protected for thousands of years by a perennial cover consisting mainly of bluebunch wheatgrass.

The farming prescription on the Palouse hills was nearly as simple as the Andean prescription. Basically, you hooked your implements to a crawler tractor and cultivated from the creek bottom right up over the hilltop. In return, you got some of the highest dryland winter wheat yields ever recorded in the world. You also got a little erosion.

This was the agricultural environment in which I collected my weekly water quality samples. The creeks of the Palouse country ran brown for most of the year, in a state of permanent spring runoff. I would fill the little 250 ml sample bottles and watch the silt slowly settle, like the snow inside of those round glass Christmas snowdomes.

Back at the University, I asked about the erosion I was seeing and was told: 5 tons. Five tons soil loss per acre per year was considered acceptable, if not sustainable. If a farmer was losing six tons or more per year, that was considered indiscreet, and would usually trigger a visit from the County Extension Agent.

So in the mornings I took Soil Science 101, learning about the Universal Soil Loss Equation. Then in the afternoons with my water quality job I learned that, in the context of modern agricultural practice; 5 tons of annual loss is ok, but 6 tons is indiscreet, that gullies a foot deep were ok, but anything more than that was unsightly and might cause problems with your implements.

Then I moved to Saskatchewan, where I began to learn about wind erosion, salinization, organic matter loss and the subtle array of political and economic forces that make us farm land that we shouldn't be farming. From there I moved to British Columbia, where the foresters tell me we don't have soil erosion, but an entirely different phenomenon they call "site degradation."

Another form of soil non-erosion we have in B.C. is known as the golf course.

Somewhere in the course of all these travels, I also became a writer, but I'll talk about that later.

So with that as an introduction, let's turn to the business at hand.

You people are a unique group, and yet I suspect that you are only just now beginning to realize how unique you are. Your situation would be similar to the grade school kid who one day realizes that he or she is the only East Indian in the class, or the only kid in a wheelchair. The act of discovering that you are that single minority, that dissenting voice in the sea of consensus, can be a shock.

You are soil conservationists; that is your unique identity, that is what sets you apart. Being marked out as that single minority may be frightening at times, but it can also be ennobling.

Soil conservationist; it is a mildly awesome mantle to wear. Society seems to be able to rationalize away every other form of environmental degradation except for the loss of soil. We have our justifications for acid rain, for dams, for dioxin, for tanker spills, for carbon dioxide buildup, but there seems to be no comeback, no rationalization, for soil loss. So you, the soil conservationists, are the achilles heel; you have the dubious honor of explaining the irrevocability of soil loss. The subject creates embarrassing silences whenever it is brought up. Soil loss and soil degradation don't seem to be fit subjects for polite company. Maybe that is why some of us tend to avoid polite company.

Contemporary society probably knows intuitively what you yourselves know explicitly, through the work of Daniel Hillel and others; and that is that no agricultural civilization in history, with the possible exception of the cultures of the Nile River delta, has ever been able to sustain its soils and its agriculture for more than a few generations. Imagine that: agriculture doesn't work! We've had some eighty years of it here, and if history is any judge, we've got another 80 years coming, and that's it.

Seems to me that is a subject everyone should be interested in.

The world also knows intuitively that soil is not a renewable resource. You soil conservationists know explicitly that soil builds at the rate of about one centimeter every three hundred years, making it renewable only in the most abstract and academic sense.

Think of it, one centimeter every three hundred years. What a benchmark. Put that in the context of the six o'clock news:

> Good evening ladies and gentlemen, this is Peter Mansbridge.
> Today, unemployment stands at 6.9 percent.
> The Vancouver Stock exchange is up two points,
> Gold is down,
> and 12.4 nanometers of soil were built today, down four nanometers
> from yesterday.

You, the soil conservationists, the marked minority, carry with you a piece of technical information that puts you in the same class as the atomic physicists; you hold the keys to, and the knowledge of, the certain destruction of civilization. Your methods, and the technologies you are master of, are somewhat slower than those of the physicists, yet the end results are no different. And the moral obligations are no different.

Society likes to think it is built on petrochemicals and computer chips. It does not like to be reminded that it is actually built on soil. Therefore, it is hard to convince anyone of the fact that organic matter return is arguably the most noble act a human being can undertake.

Soil conservation is a hard sell because society does not perceive it as a fundamental key to its survival.

Soil conservation is a hard sell because of its long timeframe. Soil conservation is a hard sell because we do not place a monetary value on the esthetics of land.

Soil conservation is a hard sell because our view of nature is based on use, or anthropocentrism. To illustrate this use based concept of nature, one only has to turn to the Federal Census of Agriculture. In that document, tucked in amongst categories like Cultivated Land, Permanent Pasture and so on, is a category that includes marshes, steep hills, and boulder fields. This category is known as Waste Land.

How incredibly arrogant we are, to officially consign a piece of nature to the garbage heap, for the sole reason that it cannot serve us.

Soil conservation is also a hard sell because of the array of institutional inducements to break marginal land, and to keep it in annual crop production. You are all more familiar than I am with the intricacies of programs like the Canadian Wheat Board quota system, the Provincial crop insurance systems, the Federal grain subsidies, and the Provincial land tax assessment system. Each of these programs, and others as well, contain subtle inducements to extensive, corner to corner cultivation.

While on the subject of tax assessment, I have a confession to make. When I was a soil assessor in Saskatchewan, every now and then I would come across a farmer who had saved a few acres of prairie or bush that was on cultivable land. In other words, the soil underneath met all the texture and horizon qualifications for cultivated land, but for some quixotic reason, the farmer had never plowed it up. My rule book told me I had to assess that land for tax purposes as if it were cultivated land, because we went by the philosophy of "highest and best use." (There is another example of our industrial relationship to land.) Well, I am standing before you today, telling you that I cheated. May the Agrologist institute strike me dead, but when I came across those quixotic little shreds of prairie or bush on good land, I lied. I called them stony, I called them saline, I gave them negative "A" horizons and I hope I helped to lock them into their natural state from now until doomsday.

But back to what I was saying. With the number of obstacles you face, no wonder the mantle of soil conservationist is a burden to wear. It carries with it an almost overwhelming set of challenges and responsibilities.

As you may have already guessed, this paper does not have a Conclusions and Recommendations section. Certainly I urge you to support the continuation and expansion of PFRA's Permanent Cover Program, one of the most positive projects to come along in a long time. Certainly I urge you to dig into the intricacies of those farm support programs and local infrastructure programs, to expose their flaws, expose the policies that encourage cultivation of marginal land, and enlist public support to get them changed. Certainly I urge you to look into expanding the markets for the products of perennial agriculture, and certainly you should look for common ground with the wildlife habitat agencies.

But I want to set out an alternate vision of soil conservation. I am beginning to realize this agenda I have laid out is certainly important, but it is not fundamental.

I am beginning to realize the key issue in contemporary soil conservation is not a political or economic issue, not an institutional or bureaucratic issue, but a personal issue.

The key task I see for the soil conservationist is the creation of individual, personal bonds to the natural landscape.

An individual bond to the landscape, be it prairie, or mountain, or tundra or riverbank or seashore, is the basis for a land morality that can guide us as we move through our modifications to those original landscapes, and can give us a permanent ethical basis for saying how, when, how much, and, occasionally, no.

I suggest that we, as western Canadian soil conservationists, do not have those personal bonds to natural landscapes, and that we damn well better make some bonds before those landscapes are all gone.

Those quiet and enduring landscapes can then become our touchstones, our benchmarks against which we can measure what we do. It was Wes Jackson who said:

> "In agriculture, we don't know what we're doing because we don't know what we've undone."

And let's face it, buried deeply in most of our agendas for soil conservation lies the hidden agenda of restoring some kind of balance between cultivated and uncultivated land, between the modified landscape and the natural landscape.

So here is my prescription, bizarre as it may seem. It is put in the context of prairie, but you can substitute whatever other kind of landscape you wish.

Go out, by yourself, leaving your bureaucratic, political, social and scientific identities behind you, find those scraps of prairie that are left, and stand there like a total jerk until you get an idea of how to build a relationship with that landscape.

Don't ask me how to do it. Maybe you can roll around on the grass like a horse in the springtime, or you can try primal scream therapy, or build a dream bed like the Indians did, or catalogue all the flora, or try restoring a damaged piece of prairie, or write about the landscape, or paint it, or reconstruct its history.

Natural landscapes certainly need us as scientists, as civil servants and as planners, but they need us even more as individuals.

Because it is the individual who can maximize commitment. It is the individual, not the committee, not the research project, not the program, that can maximize passion. And is passion the antithesis of planning? No. Passion precedes planning.

Passion and commitment are the basis for a personal, emotional bond to the natural landscapes of this great region of western Canada. When that bond is in place, and only when that bond is in place, will the symbolic mantle of soil conservationist become easier to wear.

(A reading followed, from Gayton's book, THE WHEATGRASS MECHANISM: SCIENCE AND IMAGINATION ON THE WESTERN CANADIAN LANDSCAPE. Fifth House Publishers, Saskatoon, 1990).

TAKING HUMAN RESOURCES INTO CONSIDERATION

Public or Perish

by
Gary Runka
Land Sense Ltd.

WHY DO PLANNERS NEED TO INVOLVE PEOPLE IN THE PLANNING PROCESS?

Decisions that planners make involve not only the resources in question. The decisions also involve people, people who use the resources, live near them, own the land, depend on the resources for their livelihoods and even people who attempt to protect those resources. 'People' or

> "In every area, there is not a lack of willingness on the part of individuals and citizen's groups to participate and whether we like it or not, such participation is an irreversible fact in modern societies. **And the only choice facing governments at all levels is whether to invite such participation at every stage of the decision-making process, in an atmosphere of cooperation, or whether to encounter participation after the fact, in an atmosphere of hostility. It is really no choice at all."** (Pierre Elliot Trudeau in "Citizen Involvement in Public Policy-Making" 1978)

Involving the public from the beginning not only will engender cooperative relations between planners and people, but the public expects citizen involvement as a fundamental democratic right:

> **"Participation is founded on the democratic maxim that those affected by a decision should have input into that decision."** (L.G. Smith in "Alternative Mechanisms for Public Participation in Environmental Policy-Making" 1982)

HOW DO PLANNERS DEAL WITH THE PUBLIC?

Too often planners say that public involvement is important, but they really only value the contributions of technical experts and government bureaucrats. The human resource aspect of planning is not often mentioned in the literature on soil and water conservation; when it is, the 'resource' referred to are the experts and regulators, not the people who might be most directly affected by the planning process or whose cooperation is most needed if the project is to succeed. An example of this singular focus on experts can be found in an otherwise excellent planners' reference, Conserving Soil: Insights from Socioeconomic Research by Lovejoy and Napier:

> Development of appropriate conservation policies require the input and knowledge of experts from a wide range of disciplines, Agronomists, hydrologists, engineers, soil scientists, entomologists, and climatologists are but a few of the physical science disciplines whose expertise may be required to evaluate specific conservation problems and policy alternatives. From the social sciences, political scientists may evaluate a proposed policy for political acceptability and implementability. The sociologist may consider aspects of social acceptability and adoption problems. The economist may offer input on efficiency and cost-effectiveness...

Conservation problems are inherently multidisciplinary. An interdisciplinary approach to evaluation is thus critical to reach appropriate decisions.

This decision-making style assumes that decisions should be based solely on scientific and technical considerations: people factors and values perhaps are of little consequence. However, the public's input is an important aspect to include in an interdisciplinary approach.

We must have a new approach, one which can transcend disciplinary territorialism, can apply to all levels of government, can incorporate both social and environmental concerns, and can value the knowledge and experience of the public. Conservation planning can no longer involve only technical experts but must be expanded to what Frederick Steiner calls 'applied human ecology'. This is "...an approach that can assist planners to analyze the problems of a region, or any area for that matter, as they relate to each other, to the landscape, and to the national and local political economic structure... Each problem is linked to the community in one or more specific ways...(and) this approach identifies how people are affected by these chain reactions and present options for the future based on those impacts." (From: The Living Land, Frederick Steiner).

Sometimes planners avoid public input because they feel uneasy with having to accommodate varying and often opposing points of view. These various interests may represent conflicting and seemingly incompatible values; however, conflict should not be viewed as something which is singularly negative. Conflict, when dealt with and worked through, can have a constructive function. Rather than ignoring different points of view, those views should be expressed and accommodated where possible. When faced with a situation of discord or even confrontation, the planner has available many techniques of dispute-resolution-mediation or consensus-based-negotiation which have shown promising results. It is important to remember that the prospect of an effective resolution improves dramatically when all parties feel that their views have been heard and that they have participated in the process.

TO BE MORE EFFECTIVE, PLANNERS NEED TO INVOLVE PEOPLE EARLIER IN THE PLANNING PROCESS

Not only must the public be involved in the planning process, this involvement needs to occur at the very earliest stages. Public participation is critical in determining values (normative stage) and goals (strategic stage) both of which occur early in the planning process. This is when policy and guidelines are developed to guide all subsequent operational or site specific planning. Often this formative planning stage, which affects the whole planning process more than any other, has already been completed without the participation of the public. Since the public has little input in terms of developing options and drafting plans, its input is restricted to reviewing the plans when they are nearly completed. When it participates at this stage, the focus is on details because details are all that there are left to talk about. Both the public and the planners become heavily dependent on technical experts. This is often where consultation becomes polarized and adversarial. The public has the feeling of not really being involved at all.

The public should also be involved in the later stages, after the plan is completed and is being turned into action. People need to be able to monitor the project so that they can follow-up on their contributions and receive feedback on their decisions. Also, involvement at this stage will allow people to recognize the positive effects of their participation which will increase their commitment to the process.

HOW CAN PLANNERS GET PEOPLE INVOLVED IN THE PLANNING PROCESS?

Once committed to the idea of involving people the question is 'how' to involve them:

> "The first question that decision-makers should ask themselves when confronting a complex situations is not what is the proper allocation of resources in this situation? or what should we decide?, but how should we make such a complex, difficult, and controversial decision? In other words, **the first question should be a process question (how to go about making a decision) and not an outcome question (what should be decided).**" (Julia Wondolleck, Public Lands Conflict and Resolution: Management of National Forest Disputes, 1988.)

How to make the decision and the forum of participation will determine the level of public input. Figure 1 is a modification S.R. Arnstein's 'Ladder of Citizen Participation'. It shows a range of citizen-involvement options from non-participation to citizen control.

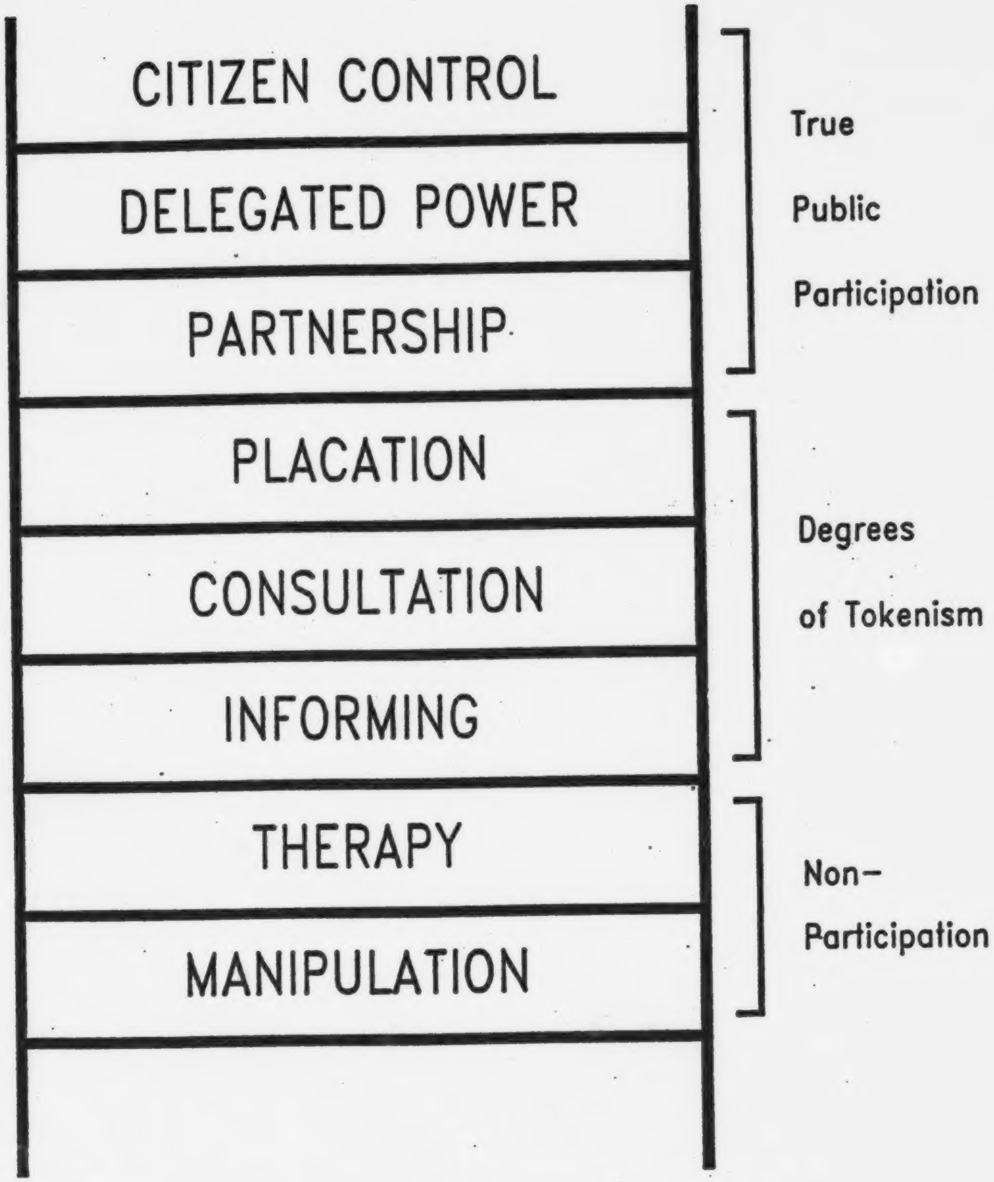
At the levels of "manipulation" and "therapy", there is little authentic citizen involvement. Rather this is a public relations exercise. The public is exposed to information, often in the context of an open house or social event, or they are "domesticated" or "pacified" through their representation on an advisory committee.

For the next three levels - "informing", "consultation" and "placation" - the public not only listens and receives information, but also provides input. Opinions and advice are sought; however, the decision-making still rests in the hands of the planners. Influence depends on the level of technical expertise possessed by the participants and on their powers of persuasion. Frustrated participants and entrenched positions are often fostered through these forums if there was not an initial consensus that this was the acceptable level of participation. Consultation and placation can be effective forms of involvement if the participants can monitor and criticize the progress of the project.

These first five levels of participation may be effective where there are not strongly held and conflicting values or where people do not feel directly threatened by the decision, but if people feel deeply involved with the project or issue, they need to be involved in the planning process.

In the last three rungs on this ladder, the public has increasing decision-making responsibilities. "Partnership" involves shared decision-making and is accomplished through negotiation or bargaining techniques such as dispute resolution mechanisms and joint-planning boards. In these situations the public representatives must be accountable to their constituencies and sufficient funds must exist to enable equal participation. With "delegated power", the public has the dominant role in decision-making, and with "citizen control" the public has full authority in the situation.

Figure 1 Ladder of Public Participation



CITIZEN CONTROL
DELEGATED POWER
PARTNERSHIP
PLACATION
CONSULTATION
INFORMING
THERAPY
MANIPULATION
True Public Participation
Degrees of Tokenism
Non-Participation

Source: Modified from Arnstein 1969: 217

Citizen Participation Objectives / Citizen Participation Techniques 1-7	1. Establish the legitimacy of your agency	2. Maintain the legitimacy of your agency	3. Establish the legitimacy of your process	4. Maintain the legitimacy of your process	5. Maint. Legit. of assumptions & earlier decisions	6. Get to know all affected interests	7. See the project through their eyes	8. Identify problems	9. Generate solutions	10. Articulate & clarify the key issues	11. Nurture & protect your credibility	12. Have your communications received & understood	13. Receive & understand communicated info.	14. Search for consensus	15. Mediate between polarized interests
1. Holding or attending meetings & public hearings															
1A. Working meetings	○	○	○	○	●		●	●	●	●	●	○	○	●	●
1B. "Open" meetings	●	●	●	●	●	●		○		●	●	●	●		
1C. Forums	●	○	●	○	●	●	●	●	○	●	●	●	●		○
1D. Public mass meetings					○			○			○	●			
1E. Public hearings	●	●	●	●	●	○		○		●	●	○	○		
2. Using citizen advisory committees	○	○	○	○	●	○	●	○	○	○	○	○	○	●	●
2A. Committees of "Gofors"	●	●	●	●	●	●	●	●	●	●	●	●	●	●	○
3. Conducting a nominal-group workshop					●		●	●	●	○			●	●	○
4. Producing & releasing materials for communication to the public	●	●	●	●	●					●	●	●			○
5. Publishing a project newsletter	○	○	●	●	○					●	●	●			
6. "Napoleon's Idiot"										●		●			
7. Educating the public about your decision-making process	●	●	●	●	●					●	●	○	○		○
8. Mapping socio-political and environmental data							○	●	●	○		○	○		
9. Presenting the public the full range of feasible alternatives		○		○	○	○	○	●	●	●	○	●	●	○	○
10. Illustrating the final form of a proposed alternative in layman's terms							●	●	○	○		●	○		
11. Dealing with the public in the agency offices	○	○	○	○		●	○	○					●		
12. Installing an ombudsman						○	○	○					●	○	○
13. Encouraging internal communication					○			●	●				○		
14. Gaming and role-playing	○	○	○	○		○	●	○							●
15. Operating a field office	○	○	○	○		●	●	○				●	○		
16. Making the most of existing organizations	●	●	●	●	●	○	○	●	○	●	●	●	○	●	●
17. Opening a channel of communication with each potentially affected interest	○	○	○	○	○	●	○	●	○		○	●	●		
18. Monitoring the mass media & other non-reactive learning					○	●	●		●				●		
19. Collecting data; carrying out surveys					○	○	●	○					●		
20. Examining past actions of an interest					○	○	●	●	○				●		
21. Experiencing empathy							●	●	○	○			○		
22. Being a "participant-observer"					○	●	●	●	●	○			●	○	○
23. Employing local citizens on the project				○		○	○	○	○		○	○	○		
24. Monitoring new developments in systems that may affect your project					○			●	●				○		
25. Conducting a background study					●		○	○	○	●		●	○		
26. Hiring an advocate for one or several affected interests			○	○	○		●	●	●	●		●	●	○	
27. Looking for analogies									○	○		●		○	○
28. Cataloging of solution concepts									●			●			
29. Conducting a "Charrette"					○			●	●	●	●	●	●	●	○
30. Mediating a conflict between different interests	○	○		○		○	●	○	●	○	●	○	○	●	●
31. Being a "good samaritan" by helping solve problems outside your scope of responsibility.	●	●	●	●	○	○	●	○	●	○	●	○		○	○
32. Monitoring the actual impacts of a project		○		○	●	●	○	●	○	○	●		○		○
33. "Delphi" technique					●		○	●	●	●	○		○	○	
	Responsibility					Responsiveness					Effectiveness				
	Citizen Participation Objectives														

● Productive technique vis à vis objective
○ Moderately Productive " "
Ineffective " "

FIGURE 2.1 Citizen participation techniques and their relative effectiveness.
(Source: Institute for Participatory Management and Planning, 1978)

The public must have access to the decision-making process, and it must also know why certain decisions have been made. It should have access to the criteria used, the reasons for the decisions and specific responses to participants' concerns. When this reasoned and inclusive public process is not undertaken, there may be a hardening of positions and resistance to implementation.

There are numerous forums for involving people in the planning process. Figure 2.1 illustrates these various techniques and their effectiveness for achieving various goals.

It is worth briefly describing the main characteristics of some of the more common forms for citizen participation.

Open houses are hosted by planners to display maps, photographs and written material. No formal presentation is made to explain the plans; it is more of a social event for the public to attend to gain information.

Written responses are received usually in response to an already formulated plan.

Public meetings are often called due to public pressure, and they are situations where planners can present a project and hear people's concerns. **Public hearings** are more formal presentations of proposals and may be a required part of provincial or federal review processes such as the federal Environment Assessment and Review Process.

Public opinion polls can be conducted through the mail, over the telephone or by face-to-face-interviews. They can be used by planners to identify issues and to set goals.

Group dynamics is a general term which refers to a number of techniques used to clarify values and goals or to resolve conflicts. These techniques could be used at various stages throughout the planning process.

A task force is a committee with a well-defined problem to explore and make recommendations about.

Citizen advisory committees are made up of representatives of community groups or citizens with special knowledge about a problem. Their purpose is to generate advice about a particular problem.

THE 'PEOPLE' SKILLS THAT PLANNERS NEED TO HAVE

Although planners must advise as to what is technically and legally possible, make information accessible, and identify possible solutions, they must also be mediators, chairpersons, cajolers, moderators, consolers and secretaries. Further, the most important 'people' skills that a planner can have are facilitator skills:

*to listen and to hear the concerns and information people (the public) are expressing
*to help parties define the real issues
*to function as an integrator
*to provide favorable circumstances under which issues can be confronted
*to remove communication blocks between the various participants and,
*to keep presenting a range of options for consideration

CONCLUSION

Once the decision has been made to encourage public involvement and genuinely take people and their concerns into consideration, the planner can acquire the skills and find the techniques to facilitate this. Public participation may mean a longer and more costly process, at least in the short term. But the benefits of a committed and involved citizenry, in my opinion, far outweigh the costs.

Public or Perish

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SOILS INFORMATION FOR CONSERVATION PLANNING

by

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ABSTRACT

The paper reviews the history of soil survey in Alberta and the soil information requirements of planners for on-farm and municipal conservation planning. Some users have experienced difficulty using a variety of map scales, classification systems, mapping concepts and products found in survey products. Soils variables useful for estimating the degree, extent and potential for wind and water erosion, soil salinity and soil acidification are identified.

INTRODUCTION

Soil survey reports and maps are the principle sources of soils data currently being used by soil conservation planners. Soil surveys in Alberta were initiated approximately 70 years ago. The information presented in the initial soil surveys reflects on what was known about soil classification and genesis. The early reports use non-technical and easily understandable language as demonstrated by Wyatt and Newton (1925) and Wyatt, Newton and Mather (1930).

As soil survey continues the level of knowledge has increased, reports have become technically complex and scientific jargon has replaced simple language. Users of the reports have been given the responsibility of deciphering and interpreting information specific to their area of interest. However, some users have little or no technical background or understanding of soil survey methods or terminology (Valentine, Naughton and Navai 1981; Souster and Peters 1991). As a result, some soil survey information is not understood and effectively utilized (Sombroek and van de Weg 1980; Valentine et al. 1981; Anderson, Skarie and Adams 1982; Valentine 1983). This is contrary to the objective of soil survey which is to provide clear, accurate and precise information to people who need to understand and use soils as they occur in the landscape (Brown 1985).

Reviewing examples of farm conservation plans reveals the lack of technical soils background that some farm conservation planners. They have limited ability in comprehending soils data as presented in soil survey reports and interpreting and translating it for the farmer. There is a tendency to present all soils data from the soil survey in a conservation plan rather than reporting just the information necessary for the farmer to make his management decisions. The plans illustrate the need for a simplified and customized soil survey report for conservation planners that is easy to use and understand. The optimal or most effective use of the information is achieved only if the user (conservation planner) comprehends all the parts of a soil survey report (Brown 1985).

Development of a product that minimizes the comprehension gap and creates a link between the users and producers of soil survey reports and maps would contribute to effective utilization of survey information. The first step in the process is to identify the soil information needs of the planners (Oschwald 1975). Their needs and requirements can then be considered in the development of alternative soil survey products.

OBJECTIVES

The objectives of the presentation are:

1. To review the history of soil survey in Alberta;
2. To describe how soil survey maps and reports have contributed to the creation of a comprehension gap.
3. To review the soil information requirements of conservation planners. A review of the history of soil survey and how soil surveys have changed in Alberta provides insight into why users have difficulty making effective use of soil survey products that were compiled during different times.

SOIL SURVEY IN ALBERTA - HISTORY

There have been 8 major developments in soil survey during the last 70 years. They are:

1. The initiation of soil surveys.
Soil surveys in Alberta were initiated in 1920 by Dr. Frank A. Wyatt of the Department of Soils at the University of Alberta (Bowser 1965). The purpose of the first survey project was to delineate the province into broad soil - climatic zones. This project was completed in 1925 (Bowser 1965; McKeague and Stobbe 1978) and the resultant map has since been revised and updated (Alberta Institute of Pedology 1967).

The second soil survey was started by F.A. Wyatt and J.L. Doughty (Wyatt and Newton 1925) in response to government concerns related to the threat of wind erosion of soils and abandonment of farms in southern Alberta. This survey was initiated in the MacLeod area in 1921 and completed 4 years later (Wyatt and Newton 1925; Bowser 1965; McKeague et al. 1978). The final report and map illustrated differences in soil texture across the surveyed area. Soil interpretations were made related to issues of soil fertility and management of soils susceptible to wind erosion. Some soil sampling was conducted during this project to characterize chemical composition of the main soils (Wyatt et al. 1925; McKeague et al. 1978). Samples were collected by depth rather that by horizon because the concepts of soil genesis and classification had not yet evolved. During the period from 1922 to 1926 over 2.8 million hectares were surveyed in the southern portion of the province (Bowser 1965; McKeague et al. 1978). Although these early maps were thematic (or single factor maps), they were an important first step in soil survey. They reflect the level of understanding of soils which existed at the time.

2. The development of the soil series concept in 1926.
This was an important stage because, in addition to surface texture, other soil profile and landscape attributes were recognized. In 1925 and 1927 C.F. Marbutt, the head of soil classification in the United States, visited Alberta. His visits were significant because he stimulated interest in the study of the complete profile and in the importance of the type and arrangement of horizons within the profile (Bowser 1965). Until this time soils were separated only on the basis of texture. Subsequent to the visits additional profile characteristics were recognized. These characteristics included differentiation, sampling and chemical analysis of soil horizons (Bowser 1965). During this period (1925 - 1927) work started on the St. Ann sheet west of Edmonton (Wyatt et al. 1930). The survey represented a step forward in mapping techniques in that it incorporated the concepts of the soil profile and the soil series. Soils were separated on the

basis of soil belts (Black, Wooded and Incipient Podsolic Wooded), surface texture, stoniness and topography. This system of classification combined genetic features and desirability for cultivation (Bowser 1965).

3. The use of the three number map legend between 1935 and 1945.

This was important because in addition to soil profile characteristics, other features were recognized. In 1935, the Canadian government passed the Prairie Farm Rehabilitation Act (PFRA), the purpose of which was to rehabilitate the drought stricken prairies. The importance of the Act was that soils information was deemed necessary and basic for reclamation and rehabilitation of lands. The area surveyed between 1935 to 1945 lay within the Palliser triangle and occupied about 8.1 million hectares (Bowser 1965). The soils were mapped at 1:190,000 using a three number code which had evolved during the St. Ann survey (Figure 1). The code characterized soil zone, type and mode of deposition of parent material and soil profile development. Soil texture was shown on the maps by a colour code and topography by cross hatched patterns. The landscape positions occupied by different soils were not recorded.

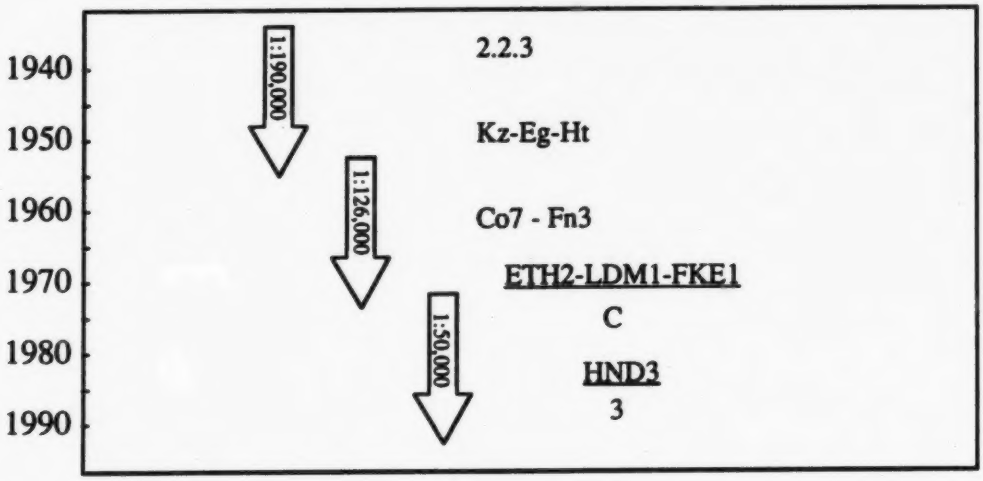

Figure 1. Map unit symbols in Alberta soil surveys (1940 to 1990)

4. The development of a field classification system for soils.

In 1945, representatives from all survey units in Canada met for the first time to exchange ideas, unify survey and classification methods and evaluate the work that had been completed to that time (Bowser 1965; McKeague et al. 1975). One of the highlights of this meeting was a proposal for a field classification system of soils for Canada. The soil series continued to be the basic unit of classification.

For the next 10 years, soils were mapped at 1:190,000 using soil series names. The proportions of soils within map units were not explicitly documented; rather, the first soil mentioned in the map unit is the predominant soil (Figure 1). Soil series were recognized on the basis of soil zone, parent material, surface texture, drainage, landscape position and some profile characteristics. Topography was noted by cross hatching. The landscape position occupied by each named soil was not described.

5. **In 1955, the first Canadian taxonomic system of soil classification was outlined (McKeague et al. 1978).**

This was a significant period for soil survey because soil series were recognized on the basis of observable physical properties. The term soil series was redefined. No longer was the series a field entity, rather it became part of the taxonomic hierarchy. The formalized system allowed the mapper to link conceptual ideas with taxonomic features. The creation of a taxonomic system also contributed to a focus on soil taxonomy in soil surveys for approximately the next 25 years. This emphasis has created many problems for those responsible for compiling, mapping and correlating soil series information because taxonomic rules forced mappers to separate soils that otherwise had very similar field properties. The result was that many similar soils series were created. Many of these series could not be easily recognized and separated in the field. The classification system was revised in 1974, 1978 and 1987 (Agriculture Canada Expert Committee on Soil Survey 1987).

In Alberta, soil surveys between 1955 and 1970 were conducted at 1:126,000 and 1:190,000. Soil legends were uncontrolled (Figure 1). In an uncontrolled legend combinations of series are not listed or described. More than one line of the legend has to be consulted to gain information about delineations that contain more than one soil (Mapping Systems Working Group 1981).

6. **The use of soil associations during the 1970's was confusing and very difficult to understand for the pedologist and layman.**

During this period there were significant changes in the way soil survey information was displayed. Maps had uncontrolled legends in which soil associations were used to characterize landscapes (Figure 1). A soil association was defined as a group of "closely interrelated soil series developed on similar parent materials and under essentially the same climates" (Dumanski, Macyk, Veauvy and Lindsay 1972). The soil associations were a combination of map units. Therefore it was possible for a single map delineation to contain as many as nine named soil series; however, proportions of the series which occupy a single map unit were not documented, nor was landscape position of individual soil series.

7. **The intergrade soil legends between present day concepts and concepts based upon soil associations contributed to the evolution of present day legends (Figure 1).**

8. **The use of controlled and closed legends beginning in the late 1970's and continuing to present.**

Presently, most legends are closed and use a combination of a soil series code and a number modifier to characterize map units (Figure 1).

Some confusion exists as the result of the use of soil series as the basic unit for soil mapping. In the last 70 years the term soil series has had several meanings. During the 1920's the term referred to a land or field unit. It was analogous to a geological formation (Agriculture Canada Expert Committee on Soil Survey 1987). Between 1935 and 1945 the concept of soil series referred to a combination of soil zone, mode of deposition of parent material and profile variation (Wyatt, Newton, Bowser and Odynsky 1938). Odynsky and Newton (1950) defined soil series as the individual soils which make up a soil catena. During this time a soil catena was defined as a group of soils developed on similar parent materials. The soil series were defined as "a result of a variety of local environmental factors that affect drainage, temperature, moisture relationships, vegetation and give rise to differences in colour, depth and structure of the profile" (Odynsky and Newton 1950). After the development of a formalized soil classification system, soil series became a taxonomic rather than a field unit. The series is presently defined as a conceptual entity that has defined limits.

The concept of the soil series and the formalized taxonomic system have changed over the last 70 years. Some series established prior to the development of the current classification system include pedons that may belong to several different subgroups, great groups or orders. For example, in Alberta, the Codesa soil series has been classified as an Orthic Gray Luvisol (Reeder and Odynsky 1965), a Cutanic Podzo Regosol (Lindsay, Odynsky, Peters and Bowser 1968) and an Eluviated Eutric Brunisol (Kocaoglu 1975).

Often only minimal problems of soil survey interpretation and understanding arise if the user has to use only one report. Once users become familiar with the style and format of a particular survey report they have few problems. The major problems arise when a user is required to contend with more than one style of map or report. Different mapping concepts, different taxonomic systems and different mappers all contribute to the potentially confusing variation between soil maps.

FARM CONSERVATION PLANNING - ALBERTA

Alberta Agriculture has produced manuals on how to prepare on-farm and municipal conservation plans as well as how to conduct salinity, soil erosion and other land degradation surveys. These surveys are costly to conduct at on-farm and municipal levels. As a result, the majority of soil and land information required for planning is currently derived from existing soil surveys.

In Alberta, soil survey information is available at scales of 1:50,000 or smaller. This level of detail is adequate for municipal conservation planning but is too general for conducting on-farm plans. Problems arise when smaller scale information is used for conducting on-farm plans especially if planners are not capable of collecting more detailed soils information.

The information that is most useful for estimating the extent, degree and potential of land for wind and water erosion is soil texture; slope length and steepness; organic matter content; agroclimatic zone; landform description; soil structure; soil drainage; soil classification (soil series); distribution of soils; and location and extent of erosion.

The information that is most useful for estimating the degree, extent and potential for soil salinity is electrical conductivity; soil classification (soil series); nature and texture of parent material; soil drainage; landform description; distribution of soils; depth to and type of bedrock; and location of salinity.

The information that is most useful for estimating the degree, extent and potential for organic matter loss is soil classification, organic matter content, location and extent of erosion and land use.

In addition to soils data some interpretive information is useful for conservation planning. The interpretations include range carrying capacity, agriculture capability, suitability of conservation tillage systems, susceptibility of soils to wind and water erosion and suitability of soils for deep plowing or ripping.

CONCLUSIONS

1. Soil survey information is required to compile conservation plans.
2. Soil survey maps, legends and reports, available for Alberta, lack consistency.
3. Soils information required by conservation planners can be difficult to extract from soil survey reports.
4. Soil survey information in Alberta is adequate for compiling municipal conservation plans.
5. For on-farm plans, conservation planners need to supplement existing soil survey information by collecting additional soils data.

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CLIMATE INFORMATION: IS IT HOT OR COLD?

by

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I listened very carefully to the presentations on conservation planning references to climate. Based on what I heard, the tone of my talk can be described by the statement "I feel that I am preaching to the converted". Climate has been identified as a recurring component of the concerns, issues, and the information needed to address them. I am not going to give a sales pitch on the use of climate information. Rather I will review some of the present uses of climate information, and suggest new ways in which it may be used.

In my view, most of the soil and water conservation problems described relate to inappropriate land use, or management. Climate information is one of the pieces of data to be considered when assessing the appropriateness of land use and management practices.

In the presentation from B.C., climate was identified as a major component of the water quality problems, because heavy winter precipitation contributed to run off, and problems with water quality.

During my five years in Alberta I have had to deal with significant drought-related problems, somewhere in the province, during three of those five years. Drought is a climate related problem that is very much a recurring feature in Alberta and throughout the Prairies. The precipitation deficits on the Prairies contribute to the agronomic and cultivation practices that are used. These practices, such as summerfallow, are identified as being associated with, or causing, the soil degradation issues that you are probably far better aware of than I am.

In Saskatchewan the Landbase information product that is available incorporates information on the probability of precipitation as one of the components, one of the pieces of information, to consider in the selection of conservation practices or agronomic practices that might be used by the farmer. In Manitoba, soil moisture management was identified as an issue.

A discussion of land management and "soil conservation" is not complete without looking at water conservation concerns. They aren't always water quality issues; in many cases they are in fact water quantity issues. Is there enough water available? Is the natural resource, the climate, providing enough water to meet the expectations of the farmer, for the level of production needed to get the returns needed to stay on the farm?

Let us examine the term "land" and consider what it means in the context of land use and management. To me, "land" means soil and climate. I believe most soils people recognize the close relationship between climate and its role in creating soils. The information used in conservation planning is spatially or areally oriented. Climate does have spatial attributes, but it also has more information that is temperol. It tells us about the year to year climate variability.

I will briefly review some of the climate information products that are available. Little of this will be a surprise to you, but it will help set the stage and provide a background. Most people are familiar with the published long term climate normals for 1951 to 1980. Soon the 1961-90 normals will be published. The Atmospheric Environment Service will be looking at different dissemination techniques, such as using CD Rom and a number of different digital information products. I think that will enhance the accessibility of these climate information products and facilitate their incorporation into conservation planning. Agroclimatic atlases are available in a variety of scales. They provide useful information that helps delineate large areas based on their climatic features. The actual daily data on temperature, precipitation, radiation, wind speed, and relative humidity are available. The temperature and precipitation data are more dense data sets. The other elements are about an order of magnitude fewer in observing locations. The reason is that the values of the other elements do not change as rapidly with distance as do temperature and precipitation.

The actual data are available in a variety of forms. If the application requires daily data, its there. There are monthly, seasonal, and annual summaries available.

There are many applications in which this data can be used. We have heard about interpretation of soils data. The same is done with climate data. Climate indicies are used. The "Land Capability Classification for Arable Agriculture in Alberta" is largely soils based, but also has an explicit climate component. The classification provides a way of rating the crop production capability of a parcel of land. One of the components that can reduce the production capability is climate, because of too short a growing season or too little precipitation.

Probabilities present temporal information that can be of value to most farmers. They are aware of a need to get the crop in the ground early to avoid fall frost problems. They are aware of the precipitation differences year to year. Climate is a piece of information that most people want to consider in the conservation planning process. Most planners want to incorporate whatever information is available. They want to add as many layers of detail as they can.

One of the impediments to incorporate climate in a substantive fashion, is the scale at which conservation planning is occurring. The sessions at this conference discuss municipal conservation planning and on-farm conservation planning. There is no way that we can delineate the climate at a farm scale. It just doesn't change over that scale. There is no doubt that microclimates exist, but these have to be identified on a case by case basis, returning to first principles and field investigation.

Microclimate is determined by elevation, aspect, vegetation, and water. Frost pockets are a good example of microclimate. Wind speed reductions behind shelterbelts is another example. We don't have a great deal of data to support this kind of information which would help delineate areas or pockets of the farm scale.

If we then look at the municipal scale, it's doubtful even then that climate can be a delineating layer. The information in the Agroclimatic Atlas of Alberta, whether it's annual precipitation or a frost free period can be of use to planners and farmers. The problem is that the lines on the 1:5.5 million scale map of Alberta, are not well suited for use on a County scale. We can't run a line down the middle of a County with confidence and say, over here we're getting less than

350 mm and over there we're getting more than 350 mm of precipitation. We know there are precipitation gradients across the landscape, but each year is very different.

Climate information can't quite fit in with the way conservation planning is heading right now. There is a conscious effort to delineate areas, to separate them on the basis of their physical characteristics. The goal is to determine how the physical characteristics are related to the kinds of soil and water conservation problems or issues that may exist, and identify the solutions or alternatives available. Climate is an associated element, which is uniform to the whole area, of a county, for example.

There may be an interaction between any of the polygons and the climate, which is uniform over the area, that gives you something more useful than just the polygons alone, it's a possibility to consider. The climate information is there but it's not one of the layers that is a delineating layer at this time.

I think there's a growing awareness of how conservation planning, as an activity, fits into overall farm planning and farm management. Right now conservation planning becomes more established, developed, and accepted, I think it will merge with the other planning activities going on.

I have noticed that the terms "information age" and "value-added" keep cropping up in the media. The information age is certainly something that has been given a tremendous boost by the increase in computer power. In the careers section there are advertisements for "Information Systems Managers". Another speaker on the program will be talking about GIS. We heard earlier about the wonderful things that are going on in Wisconsin with GIS and information technologies. I think that the true value and appreciation of climate data will emerge once we stop presenting average values or extremes of climate and use our data processing systems to present information derived from climate data. We heard in the reading by Mr. Gaton, from his book, that averages are meaningless on the prairies, it's the land of extremes. I think farmers are all aware of that.

I also heard more than one speaker refer to older farmers who might now be willing to do a conservation plan. The older farmers have a tremendous amount of experience with climate. They've lived through it, and they've experienced it first hand. I appreciate Dave Pratt's comment that we all probably have a lot to learn when we go out to a farmer's field, meet the person, and listen to what they have to contribute to the process.

What I see as the major challenge is to develop the understanding of climate. On the one hand it is intuitive, where the people have lived through it, farmed through it, and adapted to it. That needs to be combined with the more objective understanding I have of climate, without the experience of having suffered through the problems. If those two can be brought together, something positive will come out of it.

There is a tremendous amount of data available in the climatological archives. The challenge will be for climatologists to change the way we have been doing things. Climatology has evolved as a discipline from origins in geography. It has helped us understand the world in which we live. Climatic classification has proven to be very useful over the years. Climatology started with a global perspective and has worked its way down in the terms of how it is used and understood. We are now testing the limits of applicability, the scale at which we use the spatial information. The present day climatological data network is designed so that recording stations are not nearer than 40 km apart. I don't know what scale that is, but it is not a lot of stations in a county. We can't use climate information to provide layers to delineate areas at a County level when we have 25 to 40 km between stations.

What are the possibilities of how we might use the climate information? Tremendous information processing capabilities exist. GIS is one of the tools that has a very significant role to play. But one of the complaints I keep hearing is that GIS is data limited. We have this tremendous technological capability, that has so much potential but the technology is only as good as the data supporting it. As the technology starts to emerge, to mature, to find its role, I expect there is going to be another value-added component. I recall, in Dr. Niemann's presentation, they had that wonderful detail in Dane County, Wisconsin. By changing a value in the Universal Soil Loss Equation (USLE) equation they could create another map showing what things would be like. It is possible to go beyond just using the USLE. There are models, like EPIC, the CERES wheat growth model, and others that can evaluate the management of a parcel of land, had it been in place for the past 30 or 40 years?

Farm Management Specialists are planners too. They differ by dealing with financial matters. They use a process that starts by selecting a target yield, then looking at input costs, returns and finally calculating net profit. A system is in place to examine how profits change when input costs, yields and prices change. The greatest return, or margin, is the goal. It is a good process, but the shortcoming is that the chance associated with the specified outcome is not known. A response to that concern is that these farmers have been farming a long time, and know what their yields are. That may be the case, but that knowledge is incomplete.

Research on crop growth models has demonstrated a significant technology trend curve. There have been tremendous increases in productivity because of genetic improvements in varieties, use of fertilizers and changes in weed control practices. It is by no means certain that yields of 20 or 30 years ago relate to the current varieties and the production management systems in place today. It is a challenge to reconcile these two evidently disparate pieces of information.

What is the other alternative? It is just emerging and, involves the use of knowledge based systems that use crop models, which incorporate data on soils, crops, tillage practices, rotations and, of course daily weather. The models are based on the knowledge of how the biological crop and the soil responds to the natural environment fluctuations. If we have confidence that we understand the processes, whether they are erosion processes or biological life processes, then we have a tremendous tool. It can help us understand our environment, its variabilities and extremes, and help us present information to farmers. An example is a probability distribution of yields for a specific soil type, under a given production management system, or an alternative production management system. This information can be used by a GIS system. The challenge is to provide information, based on comprehensive data and knowledge of processes, so that people aren't swamped by data.

Climate is an important component of the system. One comment I often hear is "What good is climate data to me when I am preparing a conservation plan for a farm but the data was observed 25 kilometers away? I haven't had rain for 2 weeks. My neighbor got rain last Friday from a thunderstorm that went by, but I didn't get it. So how can that data be used here?" The answer is, it can't be used to describe actually what happened on a particular farm. However, the data can provide statistics and information that are valid for nearby locations. The data can represent a series of events, such as the sequences of wet and dry days, the unique situations where there was a heavy rainfall and then no rain for 3 weeks and then another heavy rainfall, or some other unique events which are so important in determining how a crop responds. I have every confidence that the climate data, over some long time, is very relevant for surrounding locations. Although a particular event didn't happen a certain year at one location, there was probably another year where things were pretty similar, where one neighbor got the rain and the other didn't.

There is useful information to be found in the long-term climate data. Some stations have a continuous unbroken record of 80 or more years. This is a tremendous data base that is relevant to understanding climate variability, and it's impact on agriculture.

A new issue that has emerged is climate change. This has led some people to conclude that the past climate record has no value or relevance any longer. Nothing could be farther from the truth. The prospect of climate change is good cause for concern. There is clear evidence that human activity has changed the atmosphere. There is emerging concensus the result will be a warmer climate.

The time frame associated with the likely changes is 30 to 50 years down the road. The conservation planning activities, that I have heard are not oriented to that time frame. Society and the agricultural industry recognize the challenge of resource stewardship and want the future to be better. Conservation planning addresses issues and concerns with the intent of implementing practices within the next five years.

The historical climatological data base that we have is still our best source of information on what is likely to happen in the near future. It is very likely that the climate we are going to see in the coming 5 to 10 years, will be within the bounds of what we have experienced. The ability to predict what the summer of '92 will be like in terms of precipitation or temperature does not exist. But I am confident that the summer of 1992 or 1993 or 1994 is going to be within the statistics we've observed over the period of climate record. It may be even prudent to expect those years to be slightly warmer than the average in the historical record. The main point is to use what we know.

There is a large quantity of climate data available to us. Unfortunately it's of limited value right now because we have not found very good ways to take this large volume of climate data and convert it into information. We recently ordered all the daily climate data recorded in Alberta, and in some cases hourly data as well, because that is the way in which radiation data is available. The data set is about 380 megabytes. It's not information, it's data that can swamp you, make you buckle at the knees because you don't know what to do with it.

The challenge is to use that data, combined with crop growth and yield models, to create a value-added product. Combining daily weather information, or monthly, or whatever is appropriate for the application, with other information that is available, will likely be the norm in the future. Detailed soils, fertility, herbicide, and pesticide applications, crop rotations, and tillage practices can also be incorporated to provide farmers information about what can happen in their operation and circumstances. The Can-Help Program, is an example of a tool that provides information on options. I fully believe that that kind of tool is going to grow in frequency of use.

In the future there will be more sophisticated computer hardware and software, running models, GIS and other applications. A farmer may come into an office, sit down, enter the details of the farm operation and run through a pile of scenerios to help make a decision. The climate information will be part of the system in the years to come, in the meantime it can provide information on rainfall intensity, so that the appropriate data can be used in the Universal Soil Loss Equation, or others. The rainfall rates at times when soils are susceptible can be used instead of the peak rates for the year, which may likely occur when the soil isn't as susceptible to water erosion.

There is a variety of climate information that can be used to help specialists fine tune and refine recommendations. As the information age emerges, so will the ways in which climate data will be converted into information to help guide decisions.

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WATER INFORMATION: WHERE DOES IT FLOW?

by
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INTRODUCTION

I want to thank the organizers, especially Leon Marciak and the Soil and Water Conservation Society (SWCS) - Alberta Chapter, for the opportunity to make this presentation. The Society as many of you know added "water" to its name in the past four years in recognition of water's importance in conservation.

Agriculture is the main land use on the prairies. Production strategies and practices of the land managers(owners), international markets and government programs can be considered the principal influences on the landscape.

I will be speaking on the important roles of water from a non-irrigation perspective in this landscape and will describe how water fits into the context of municipal and farm conservation planning. I will indicate the information required and sources of this information, and outline interpretation approaches for water in conservation planning. The approach I have taken will identify the key water factors and will allow for the easy incorporation of them within the planning framework. This could lead to an "expert systems" approach to landscape planning.

WHY IS WATER IMPORTANT FOR CONSERVATION PLANNING?

Don Rennie, Dean Emeritus of Agriculture at the University of Saskatchewan, in his presentation at the 1990 Soil Conservation Workshop confirmed "The Solution to Soil Conservation is Water Management" - - He stated "Those involved in soil conservation are really managing their available water more efficiently...... If you increase your water use efficiency that is, the yield per hectare per centimetre of precipitation, you directly improve your management of soils". Water conservation is an integral part of landscape management - for soil conservation, crop production, livestock production and domestic use.

Quantity of water supply, timing, form(i.e.snow or rain) and quality are the issues land managers have to consider in planning and implementing production strategies to make efficient use of water.

Other important planning considerations include:

*Permanent and temporary wetlands(i.e. prairie potholes) for which a policy is being developed for Alberta. This Policy will have special interest for some land managers because it will include a definition of temporary wetlands and management options for agriculture and wildlife, especially waterfowl production.

*Droughts - Water or moisture shortages occur somewhere in Alberta (prairies) every year due to our dry climate. Droughts result in yield reductions and a limited range of crops. Planning is required to minimize drought risk and the cumulative impacts.

*Evaporation/transpiration on average reduces the effectiveness of precipitation by forty (40) per cent in Canada (hydrological cycle). More on this a bit later.

*We as agrologists, engineers and planners need to factor in to our conservation planning activities how much water is needed and when. We need to know the chance or probability of receiving sufficient amounts of precipitation for current needs and regeneration. Land managers need to consider what their water requirements are during the various production cycles and to determine if their sources are sufficient to meet these requirements.

SOME AGRICULTURAL PERCEPTIONS AND ROLES IN WATER MANAGEMENT

At present water conservation and integrated water management are often given insufficient emphasis in farm and municipal conservation planning. This is partially due to a lack of trained specialists in agriculture water management. As well, past and present funding programs have tended to emphasize soil conservation much more readily than water conservation. In fact, one of the results of the CASCI program is the understanding that water management requires a higher portion of support and it must be integrated into farm planning.

At Alberta Agriculture, we are trying to rectify this through programming and staff retraining, and on-farm water management - rather than just draining away problem water. We are also working very closely with other agencies like Alberta Environment, Alberta Forestry, Lands and Wildlife, NAWMP, and Ducks Unlimited to create farm-level and municipal plans which integrate agricultural and non-agricultural uses. Alberta Agriculture is involved in negotiations for a new federal provincial environmental initiative which will have a major emphasis on water conservation. This will help create rural and urban awareness of the role of water. The potential also exists for Alberta Agriculture to become one of the greatest promoters of the NAWMP through our network system of extension personnel and the linkage to the rural municipalities.

What Water Information Is Necessary For Conservation Planning?

*Climate
The principal climate factors include daily temperature (maximum/minimum), rainfall, snowfall, and total precipitation. For Alberta, the process of assembling this information has begun through the Municipal Climate Information Package and the Climate Atlas.

*Weather
Alberta Agriculture has developed a working relationship with Atmospheric Environment Service (AES) to provide daily (updated five times) forecast for agriculture through a dial-up Farm Weather Line Program. AES has also continued to expand the Weatheradio network with an estimated 20% of Alberta's agriculture landscape presently receiving coverage for continuous weather forecast.

*Soil survey
Alberta has soil surveys of varying quality. Soil surveys are useful for water management because they provide information relating to a crop's ability to utilize soil moisture, water holding capacity, impervious layers, subsurface texture and water table. This provides direction on the need for root zone drainage. In almost all cases farms will require additional sampling to confirm soil and landscape characteristics for effective farm-level planning. Full provincial coverage in the form of a digitized soil survey is the goal of Alberta Agriculture.

*Snow Surveys

Snow surveys are important since approximately 25% of soil moisture and up to 75% of livestock and domestic water are obtained from snowmelt. Snow water equivalents (SWE) are determined over the Canadian Prairie Region using satellite passive microwave data. Traditional snow surveys are costly and the aerial coverage is poor. The year-round all-weather capability and frequency of satellite coverage allow for the daily monitoring of regional SWE conditions. A major advance in the remote sensing of snow cover has been the continuing development and assessment of algorithms to derive snow depth, water equivalent, areal extent and snow state (wet/dry), using passive microwave sensors with their all- weather and day/night capability.

The SWE map (1:2,000,000) provided by Alberta Environment is used in conjunction with other data sources to make assessments regarding potential spring runoff patterns. Alberta Agriculture's 1990 Spring Soil Moisture Map was modified based on the information provided in the SWE mapping product.

*Hydrology

Hydrological indicators related to runoff can be helpful as a part of conservation planning especially if drought is a problem. These indicators include surface water levels (i.e.lakes, sloughs, dugouts etc.), shallow groundwater well levels and water balance information.

Lake levels are a good indicator of an area's runoff conditions. They provide an insight to both the magnitude and duration of low runoff periods. A review of provincial lake levels was undertaken during the fall of 1991 by Alberta Environment because of recurring drought in eastern Alberta. The evaluations showed lake levels in the whole eastern half of the province and in the Grande Prairie area were below normal.

Groundwater Well levels are continually evaluated, also by Alberta Environment through a 238 sites Groundwater Observation Well Network throughout the province. 77 are shallow (<20 metre depth) and 10 of the 77 have declined in level since 1988 varying from a high of 0.75 metre to a low of 0.0685 metre.

Water Balance can illustrate the causes of water deficiencies. The situation shown on this transparency occurred in the 1980's in the Beaver River Basin in northeastern Alberta:

	Normal Conditions (mm)	Drought Conditions (mm)	Change	
			(mm)	(% drop)
Precipitation	442	375	67	15
Evapotranspiration	364	332	32	9
Surface Runoff	47	20	27	58
Subsurface	31	23	8	26

You can see that a 15% decline in precipitation can produce a 58% decline in surface runoff and a 26% decline in water entering the subsurface. The reason for this is the comparatively small (9%) decline in evapotranspiration. Simply stated, evapotranspiration gets the first opportunity to use precipitation. Since most of

Alberta is in a zone of moisture deficit (i.e. actual evapotransporation is regulated more often by moisture availability rather than energy) precipitation is readily evaporated leaving little water for runoff. This moisture-deficit situation is true for most parts of the prairies.

The hydrology database we use for farm water management (small watershed) projects is obtained from Alberta Environment. The present data is derived from large watersheds and there is some question of its reliability for small watersheds. More data on runoff characteristics for small watersheds is required.

*Satellite Imagery

Alberta Agriculture has been using NOAA-NDVI satellite imagery for the past three years as a cost effective drought monitoring tool for pasturelands and annual croplands. Weekly images are received from Statistics Canada - Agriculture Division and sent to extension specialists throughout the province. Satellite imagery is being used by a number of other agencies including Ducks Unlimited for the NAWMP landscape planning effort.

*Aerial photography

Aerial photography (colour or black and white 1:20,000 blown up to 1:5000) is probably the most useful, inexpensive aid for water conservation planning. Numerous landscape features (i.e. watersheds, basins, elevations etc.) can be determined as well as historical comparisons of land use.

Topographical data sets can be ordered in digital form through Maps Alberta but this is very expensive at $1000 per map sheet.

*Scale

The recommended data sets and final products for water conservation planning should use the following scale standards:

- Provincial 1:500,000
- Regional 1:250,000
- Municipal 1:20,000 to 1:100,000
- Farm 1:5,000

WATER USAGE

*Livestock Water Usage

Water quantity and rate of usage by livestock is shown in the following table:

	l/d	M^3/Head
Dairy	36	60
Dairy - Winter only	45	20
Pigs	15	6
Layers(100)	27	11
Broilers(100)	27	11
Turkeys(100)	38	17
Beef	57	25
Beef - winter only	34	15
Sheep	9	4

These data sets are important for sizing the reservoir (the design has to take into account evaporation), well capacity or a combination of both, and for identifying the watershed size to obtain sufficient runoff to meet the supply requirements. There is a strong link to snow management techniques as a method of refilling reservoirs in the spring.

*Crops Water Usage
The next slide shows moisture requirements for crops:

Crop	Annual Moisture Requirements (mm)	May (mm/d)	July (mm/d)
Forages and pasture(Alfalfa)	500 - 700	6	7.5
Annual Crops	300 - 500	3	8
Oilseeds	400 - 500	3	8
Other crops	400 - 500		

The rate of crop moisture use is most important during the flowering stage. Moisture stress at this stage will seriously limit yields. If precipitation or stored soil moisture is low during this period then water retention measures should be considered in farm conservation planning. For example, present research indicates snowmelt runoff management and infiltration through a water retention (backflood) project is a useful production strategy. The backflood improves soil moisture levels and therefore increases yields and allows improved soil management through more residue for organic matter and erosion control. Looking at the "soil as a reservoir" is a practical way of viewing soil moisture and fertility relationships in the root zone.

*Salinity is a water problem. In some cases too much water has percolated beyond the root zone and therefore out of reach of the plant. In some cases, it is ironic the plant is suffering from moisture stress while too much water is present beyond the root zone.

*Domestic Water Use
The average water usage for household purposes is 350 litres/day. Of this only 5% is used for drinking and 75% is used in the bathroom.

*Water Sourcing
The principal water sources in Alberta for livestock and domestic uses are dugouts and ponds, wells, rivers, lakes, etc. The reliability and quantity of water available from these sources is an important factor in conservation planning.

WATER QUALITY

*Livestock
To assess the suitability of a water supply for any class of livestock, you must consider each case individually, giving attention to the class and physical condition of the animals, the environment, the feed and the water quality. The reason for this approach is more fully explained in the following excerpt from the National Academy of Sciences publication entitled "Nutrients and Toxic Substances in Water for Livestock and Poultry" (p.51-52):

> "Whether from natural or human sources, water occasionally contains elements or substances in toxic amounts. Unfortunately, only limited information is available on experimentally determined toxic levels of various substances in water for livestock and poultry. Good judgment is necessary when applying information reported in the literature to practical situations. So many conditions are involved in determining whether or not certain levels of a toxicant will cause harm that no single concentration can be accepted as dangerous in all situations."

*Herbicide performance
Water quality factors can reduce the effectiveness of certain herbicides. These factors include levels of Organics- (algae, organic matter), Minerals- (calcium, magnesium, iron, sodium, zinc), Silts-(suspended), and Acidity/Alkalinity (pH).
High water volume and low herbicide concentration may further reduce efficacy by reduced surfactant to water ratio, reduced herbicide to water ratio, and increased cation ratio.
Herbicides affected by water quality factors include:

1. 2,4-D - Decreased efficacy by:
    a)sodium bicarbonate
    b)magnesium sulfate
    c)sodium sulfate
    d)sodium chloride

2. Sethoxydim (Poast)- Decreased efficacy as a result of high concentration of sodium carbonate and sodium bicarbonate

3. Glyphosate (Roundup)- Decreased by cation CA++, Fe++ and Zn++ and anion HCL

*Domestic Water Quality
The standard information source to follow for domestic water quality is the "Guidelines for Canadian Drinking Water Quality" (1987) published by Health and Welfare Canada.

In the absence of specific water quality guidelines for particular water sources, land managers who are uncertain of its quality for the various uses should have the water supply analyzed whenever a new water source is constructed.

Where Do You Get The Information For Effective Water Management Planning?

*Landowners
- water sources
- volume
- quality
- cropping history
- livestock type and numbers
- production practices
- approach to planning and decision making

*Alberta Agriculture
- Conservation Manual Series - Farm Water Management
- Climate Atlas
- Municipal Climate Information Series
- Climate Display
- Soil Moisture Management Movie and Display
- Water Management Movie and Display
- Farming for the Future Projects Reports
- Spring and Fall Soil Moisture Maps
- CASCI Reports
- CARTT Reports
- ASB Soil and Water Conservation Project Summaries
- Applied Research Reports
- Technology Transfer

- Crop Protection Updates
- Numerous factsheet publications including "Water Analysis Interpretation" - Adgex 410/716-2, "Chemical Analysis of Farm Water Supplies" - Adgex 716, "Water Requirements For Livestock" - Adgex 400/716-1 etc.
- Dugout Pumping Program
- Livestock and Forages Relationships to Soil and Water Conservation - a literature review (available in 1992)

*Alberta Environment
- Water Resources Act
- Hydrology - surface water
- Hydrogeology - groundwater
- River Forecast Center

*Alberta Water Resources Commission
- Interdepartmental/agency partnerships
- Drainage Potential in Alberta: An Integrated Study (1983-86)
- Subbasin Water Management Planning Program (1984 -)
- On Farm Water Management Study (1987-92)
- Water Management in the South Saskatchewan River Basin (1984-86)

*Agriculture Canada/PFRA
- Agro-ecological Resource Areas of Alberta (1989)
- Intergovernmental Memorandum of Agreement for Water Management
- Soil and Water Conservation Service
- Numerous publications including "Dugouts for Farm Water Supplies"
- Groundwater - PFRA Water Sourcing Study

*Alberta Research Council
- various databases including SIDMAP and soil surveys
- surface water management modelling

*Alberta Forestry, Lands and Wildlife
- Land Resource Information System (LRIS) - protocol and standards for automated information collection and distribution.
- Public Land Act
- Integrated Resource Development Planning
- Maps Alberta

*Transportation and Utilities
- Corridors planning and construction
- Rural Water Pipeline Program

*Soil and Water Conservation Society
- Journal of Soil and Water Conservation
*Private Consultants
- Feasibility Studies
- Monitoring

How Do You Analyze Water Information For Your Planning Purposes?

*There is a great deal of water management information available. The challenges are to put it in a usable form, to identify gaps and requirements to fill the gaps (i.e Snow Water Equivalent) and to transfer the information to improve decision making.

*Water Conservation Planning seminars have been initiated by Neil MacAlpine, Farm Water Management Engineer, for Alberta Agriculture. Neil assumes his audience of Agricultural Fieldmen and District Agriculturalists have received training from Tom Goddard's Farm Conservation Planning Workshop. The following series of overhead transparencies form the basis for Neil's approach:
- Choosing an Extension Technique;
- Overview of On Farm Water Management;
- Values in Water Management (3);
- Wetlands;
- How Does a Municipality Value Water? Wetlands? How Do Your Producers?;
- Economic Relationships;
- Resource Information;
- Resource Information - interpretation;
- Production Perspectives;
- Production practices and How They Value Water - livestock, cereals, high value crops;
- Wildlife Perspectives - waterfowl needs;
- Farm Water Management Demonstration site plans

*Agro-Ecological Areas
A number of provincial government resource departments in Alberta, including Agriculture, are looking at adopting an agro-ecological classification system for program implementation. This classification was developed by Agriculture Canada and Alberta Agriculture in the late 1980's. The main unit for the data organization is based on agroclimate, landform, soil classification and texture characteristics. The implication for water management planning is the integrated approach to agricultural data management and land evaluation research.
Watersheds and their sub-basins as part of the agro-ecological regions could form the basis for water management planning.

*On Farm Water Management Study (1987 - 1992)
The Study is an example of an interagency, integrated agronomic, hydrologic, economic and waterfowl study that could be used in planning. Data from six farm water management sites in central and northern Alberta were collected on the following: control drainage structures, grassed waterways, surface or subsurface drainage, storage (slough consolidation for livestock and waterfowl), soil moisture management, and domestic water supply. The challenge for the Study, now in its final stages, is to integrate the findings after evaluating the major components. The Study has helped already in a number of ways including future project design, inter-disciplinary coordination and long term consultant - public service contractual arrangements.
*Municipal Conservation Planning Pilot Project
This major interagency effort has identified many of the water components I have previously mentioned. The project results should improve the role of water in conservation planning (attitudes) as well as provide direction for future efforts. The project has also focused on partnerships, automated information analysis and display, funding commitments, and conservation programming based on planning.

What Have We Tried To Say About The Role Of Water Management In Conservation Planning?

Water should be an equal partner with soil in conservation planning. Second only to human resources, WATER is "the" most important consideration and should not be treated as a "Hidden Element" of Conservation Planning.

The reliability and quantity of water available from the sources is an important factor in conservation planning.

Water quality factors can severely limit supply in an already deficit region.

Evapotranspiration gets the first opportunity to use precipitation.

There is a great deal of water management information available. The challenges are to put it in a usable form, to identify gaps to fill the gaps (i.e Snow Water Equivalent) and to transfer the information to improve decision making.

Technology transfer efforts will need to continue to focus extending the results from water management applied research and demonstrations as the principal information generation tools for land managers. Training of our principal clientele through water conservation planning seminars will continue to be a focus of our technology transfer effort.

Interdisciplinery partnerships and cooperative funding arrangements will continue to be needed to manage land use conflicts (AWRC; NAWMP; MCPPP; DU: WHC)

and finally urban attitudes toward agriculture land use and farm practices are changing and we will need to respond in a proactive manner (i.e.confinement livestock concentration including production banks of 250 sow farrow to finish operation etc.).

Thank you.

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VEGETATION INFORMATION FOR CONSERVATION PLANNING

by
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INTRODUCTION

In this presentation I will be covering three topics:

1. How to define vegetation information needs.
2. Current sources of vegetation data.
3. Examples of vegetation data analysis using a GIS.

While I cannot give a cookbook approach to using vegetation data in soil and water conservation planning, I will attempt to give you an overview of how vegetation data could be used effectively in the planning process.

DEFINING VEGETATION INFORMATION NEEDS

There are two phases to defining information needs:

1. Determining data requirements.
2. Developing the information model.

Determining Data Requirements

Determining data requirements for soil and water conservation planning requires that the planner develops an understanding of:

1. The goals and objectives of the planning exercise.
2. The scope of the plan in terms of integration with other resources.
3. The level of planning that is being done.

The goals and objectives of the planning exercise are developed through an evaluation of issues and through a definition of the scope of the exercise. Specific goals will require specific types of information. A clear definition of these will help pinpoint information needs.

The scope of the plan is one of the key factors in determining information content requirements. For example, if you are dealing only with soil erosion issues, the type of vegetation information required is quite different than if you are also dealing with wildlife habitat issues.

The level of planning defines the scale of the information required and to some extent the content of the information. A provincial level planning exercise will require an entirely different scale of information than a municipal level plan or a detailed farm plan. At the one end of the spectrum, broad scale vegetation classifications are useful while at the detailed level vegetation maps describing specific vegetation cover types are probably necessary.

Developing the Information Model

Prior to assembling or collecting information for planning it is very useful to develop an information model. This exercise will assist in defining data content, format and the analysis procedures required. Development of an information model starts with deciding what decisions will have to be made in the planning process. Once we know what decisions will need to be made we can then define the general information types which will be required to support the decision process and the scale of the information required. The next step is to define how the data needs to be analyzed and presented. This will assist in the definition of the format of the information and the content in terms of data elements.

The other aspect of the information model that needs to be considered is the information needs for monitoring the success of a plan after implementation. Think in terms of how success will be measured and what information and analysis procedures are needed to support that assessment.

Summary

To summarize, the key points that need to be addressed in defining information needs are:

1. Information collected must be relevant to issues, scope, and goals of the planning exercise.
2. A model for using the information must be developed to ensure that the information is used effectively and efficiently.
3. The plan should address information needs through all phases of the process from problem identification through to implementation and monitoring.

SOURCES OF VEGETATION INFORMATION

There are a number of sources of vegetation data that may be of use for conservation planning. These range from 1:1,000,000 scale data, which may be of use for broad overview planning and establishment of generalized goals and objectives, to large scale data at 1:10,000 or 1:20,000 that would be used for municipal planning activities or for on farm planning activities.

Vegetation data can be grouped into two basic types; ecological data and vegetation cover data. Ecological data is mapped with reference to soil or landscape units i.e. polygons are defined on the basis of landscape as it reflects relatively homogenous ecological conditions. Vegetation within these units is then described in terms of plant communities which characterize the ecological conditions. Vegetation cover data, on the other hand is mapped on the basis of vegetation patterns. Polygon boundaries may or may not reflect changes in ecological conditions.

Ecological Information

A common source of ecological information are Ecological Land Classification maps. These can range in scale from 1:1,000,000 at the Ecoregion level to 1:10,000 or larger at the ecosite level (Figure 1).

FIGURE 1. ECOLOGICAL LAND CLASSIFICATION

LEVEL OF CLASSIFICATION	SCALE
1. ECOREGION	1:1,000,000
2. ECODISTRICT	1:250,000
3. ECOSECTION	1:100,000
4. ECOSITE	1:10,000

At the Ecoregion level vegetation is described in terms of broad patterns which reflect climatic conditions. At this level of detail we can only draw broad inferences for conservation planning, for example we would expect different conservation problems in the Aspen Parkland than in the Mixed Grass Prairie Ecoregion.

The Ecosection level (1:100,000 scale) deals with somewhat more specific information. Map units are defined in terms of topography, and vegetation patterns are described within these units. This level of data could be used for targeting potential problem areas. For example, areas of rough topography with low cover of natural vegetation could be an area of concern to the conservation planner.

More detailed information is collected at larger scales at the Ecosite level. Here we are dealing with defining specific plant communities within landscape units.

Vegetation Cover Information

Vegetation cover is commonly mapped in Alberta at two scales - 1:100,000 and 1:20,000. The smaller scale is referred to as the Reconnaissance Vegetation Inventory while the 1:20,000 scale is referred to a the Alberta Vegetation Inventory.

Reconnaissance Vegetation Inventory:

The Reconnaissance Vegetation Inventory was developed primarily for wildlife habitat identification. Information collected (Figure 2) identifies vegetation patterns in terms of physiognomic descriptions such as closed or open forest, grassland, cultivated land etc. This data is obtained largely from satellite imagery and is relatively inexpensive to acquire. These maps could be applied at the municipal level to give an overview of the vegetation patterns. When combined with soil and topographic data these maps would be an excellent source of data for identifying potential soil and water conservation problem areas. They also provide a good overview of wildlife habitat areas and show the distribution of wetland. The habitat information becomes more relevant to conservation planning as the context is broadened to include integrated management of other resources in addition to the agricultural resource. It is intended that this information be digitized and used with geographic information systems for habitat modelling and that the maps be updated to reflect changes in vegetation patterns over time.

Alberta Vegetation Inventory:

The Alberta Vegetation Inventory was developed primarily as a forest inventory. As a new inventory to replace the Phase 3 forest inventory was being developed, it was realized that to adequately manage forest lands, information on more than only the forest resource was needed. As a result information for wildlife habitat identification and for grazing concerns was included in the inventory (Figure 3). Some of the attributes collected beyond forest information include descriptions of vegetation patterns such as open or closed shrublands, grasslands, cultivated lands and water bodies. The specifications call for mapping of these features to a minimum polygon size of two hectares.

The Alberta Vegetation Inventory was designed for use in a geographic information system. When combined with other information layers such as soils, topography or hydrography this data could be used for sophisticated analysis of conservation problems. An example I can think of would be an analysis of vegetation patterns in relation to stream courses to determine how much disturbance has occurred in what proximity to streams. This data could then be correlated with water quality data or with the occurrence of visible erosion features to target areas where remedial measures should be taken. Another analysis may be the identification of vegetation types around wetlands and sloughs. This would be useful for waterfowl habitat analysis and subsequently developing plans to encourage farming practices that enhance waterfowl habitat.

The Alberta Vegetation Inventory was initiated in 1987 and approximately 600 townships have been mapped to date. These fall mainly in the white area of the province along the forest fringe area (Figure 4). This mapping will likely be conducted primarily in the forested area of the province in the future as it was designed as an inventory used to manage resources. Forest management agreement holders have agreed to provide their inventory data to the Alberta Vegetation Inventory specifications. This will result in a common data base that will be used by both government and industry for the management of the forest resource.

VEGETATION DATA ANALYSIS USING A GIS

Forest data analysis
Wildlife habitat analysis
Grazing application

FIGURE 2

RECONNAISSANCE VEGETATION CLASSIFICATION

1. NON-VEGETATED COVER TYPES (<10% plant cover)

1.1 ANTHROPOGENIC COVER TYPES (man-induced cover types)

NAC - Cities, towns, industrial developments
NAR - Roads, highways
NAS - Surface mines, gravel pits, spoil piles

1.2 NATURAL COVER TYPES

Water
NWL - Lakes, ponds (includes reservoirs)
NWR - Rivers, streams

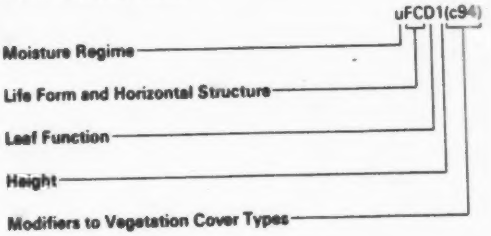
Mineral
NMI - Ice
NMR - Rock, talus
NMS - Sand, soil, alluvium, alkali flats, beaches

2. VEGETATED COVER TYPES (>10% plant cover)

2.1 ANTHROPOGENIC COVER TYPES (cultivated lands)

CA - Annual crops
CI - Irrigated crops (perennial or annual)
CP - Perennial forage crops
CPH - Hayland (usually harvested at least once a year)
CPI - Improved pasture (grazed by livestock and seldom harvested)
CPR - Rough pasture (same as CPI but with >10% woody plant cover)

2.2 NATURAL COVER TYPES


uFCD1(c94)
Moisture Regime
Life Form and Horizontal Structure
Leaf Function
Height
Modifiers to Vegetation Cover Types

2.2.1 Moisture Regime (if symbol is absent, assume upland)

u - Upland (terrestrial lands neither flooded nor saturated any time during the year)
w - Wetland (lands transitional between terrestrial and aquatic; water table is at, near, or above the surface some time each year)
a - Aquatic (permanently flooded areas that are >2 m deep at low water level)

2.2.2 Life Form and Horizontal Structure

F- - Tree Vegetation (trees have >6% cover)
FC - Closed Forest (tree cover is >20%)
FO - Open Forest (tree cover is 6-20%)
S- - Shrub Vegetation (Multiple-stemmed woody plants predominate, shrub cover is >25% and tree cover is <6%)
SC - Closed Shrub (crowns of most shrubs are interlocked)
SO - Open Shrub (crowns of most shrubs are not touching each other)
H- - Non-woody Vegetation (non-woody plants predominate; tree cover is <6% and shrub cover is <25%)
HG - Graminoid (grasses and/or sedges)
HF - Forb (non-graminoid herbaceous plants)
HE - Herb (graminoids and forbs)
HB - Bryophyte (mosses and/or liverworts)
HL - Lichen

2.2.3 Leaf Function (applies only to tree or shrub cover types)

C - Needle-leaved Coniferous (>80% of woody cover is of needle-leaved plants)
D - Broad-leaved Deciduous (>80% of woody cover is of broad-leaved deciduous plants)
E - Broad-leaved Evergreen (>80% of woody cover is of broad-leaved evergreen plants)
M - Mixed Needle-leaved and Broad-leaved (each type has approximately 50% of the woody cover)
N - Mixed, Needle-leaved Dominated (needle-leaved plants have 60-80% of woody cover)
B - Mixed, Broad-leaved Dominated (broad-leaved plants have 60-80% of woody cover)

2.2.4 Height (applies only to tree or shrub cover types)

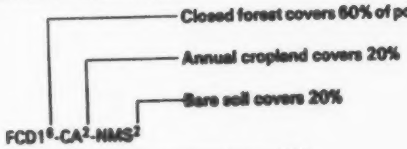
Tree Vegetation
1 - Tall (>6 m in height)
0 - Low (<6 m in height)

Shrub Vegetation
0 - Dwarf (<0.5 m in height)
1 - Low (0.5 - 2.0 m in height)
2 - Tall (2.0 - 6.0 m in height)

2.2.5 Modifiers to Vegetation Cover Types

(c94) - Clear cut in 1940's
(b89) - Burn in 1890's
(s) - Modifies non-woody vegetation cover to indicate a sage brush component

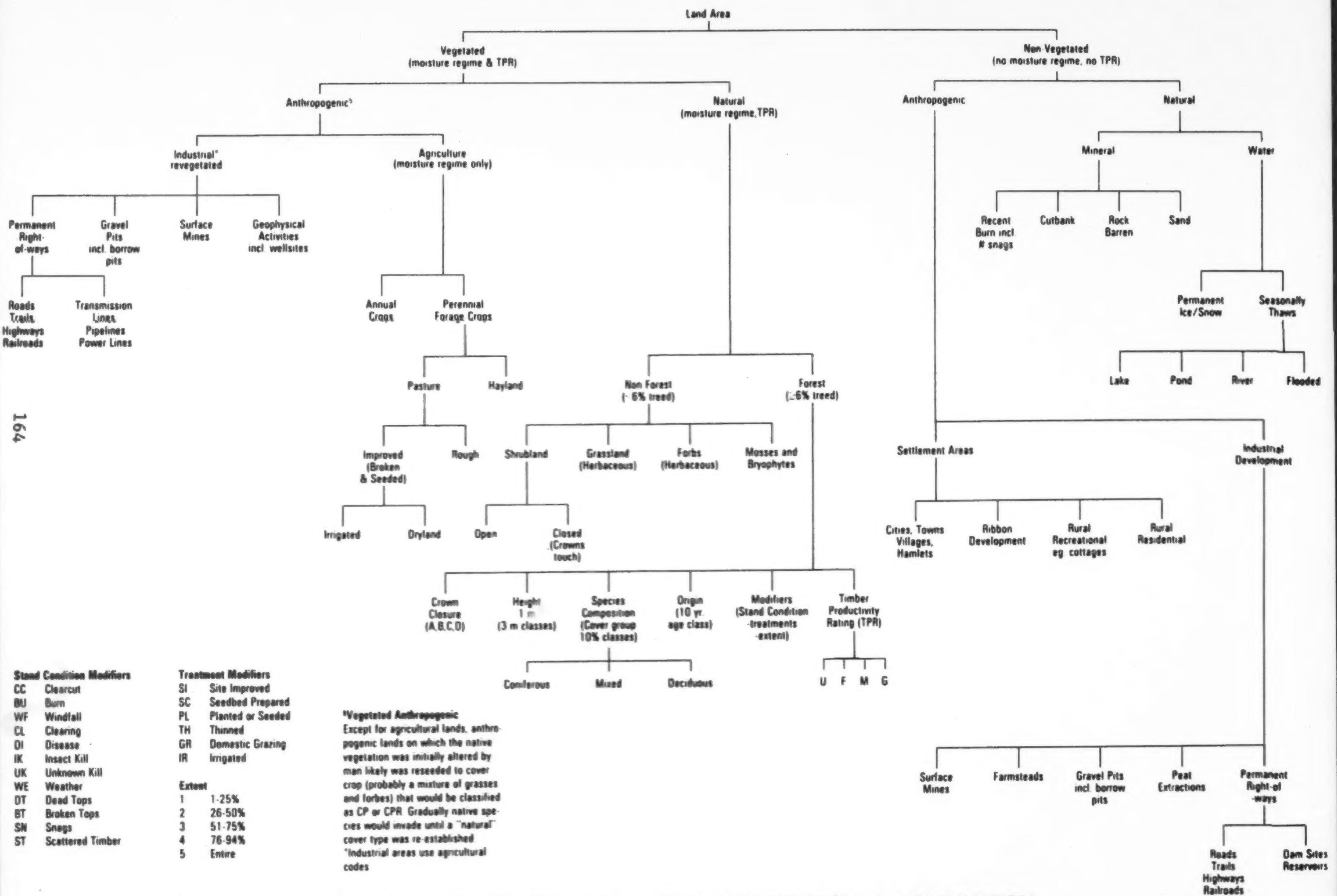
MAPPING CONVENTIONS


Closed forest covers 60% of polygon area
Annual cropland covers 20%
Bare soil covers 20%
$FCD1^6$-CA^2-NMS^2

Dashes (-) separate the cover type symbols.

FCD1/HG

Oblique line (/) separating two or more cover types indicates the types occur together in a recurring mosaic pattern (Example: Intervening deciduous forest and grassland patches).


Land Area
Vegetated (moisture regime & TPR)
Non-Vegetated (no moisture regime, no TPR)
Anthropogenic[5]
Natural (moisture regime, TPR)
Anthropogenic
Natural
Industrial[6] revegetated
Agriculture (moisture regime only)
Mineral
Water
Permanent Right-of-ways
Gravel Pits incl. borrow pits
Surface Mines
Geophysical Activities incl. wellsites
Recent Burn incl. # snags
Cutbank
Rock Barren
Sand
Roads Trails Highways Railroads
Transmission Lines Pipelines Power Lines
Annual Crops
Perennial Forage Crops
Permanent Ice/Snow
Seasonally Thaws
Pasture
Hayland
Non Forest (< 6% treed)
Forest (≥6% treed)
Lake
Pond
River
Flooded
Improved (Broken & Seeded)
Rough
Shrubland
Grassland (Herbaceous)
Forbs (Herbaceous)
Mosses and Bryophytes
Settlement Areas
Industrial Development
Irrigated
Dryland
Open
Closed (Crowns touch)
Cities, Towns Villages, Hamlets
Ribbon Development
Rural Recreational eg. cottages
Rural Residential
Crown Closure (A,B,C,D)
Height 1 m (3 m classes)
Species Composition (Cover group 10% classes)
Origin (10 yr. age class)
Modifiers (Stand Condition -treatments -extent)
Timber Productivity Rating (TPR)
Coniferous
Mixed
Deciduous
U
F
M
G
Surface Mines
Farmsteads
Gravel Pits incl. borrow pits
Peat Extractions
Permanent Right-of-ways
Roads Trails Highways Railroads
Dam Sites Reservoirs

Stand Condition Modifiers

CC	Clearcut
BU	Burn
WF	Windfall
CL	Clearing
DI	Disease
IK	Insect Kill
UK	Unknown Kill
WE	Weather
DT	Dead Tops
BT	Broken Tops
SN	Snags
ST	Scattered Timber

Treatment Modifiers

SI	Site Improved
SC	Seedbed Prepared
PL	Planted or Seeded
TH	Thinned
GR	Domestic Grazing
IR	Irrigated

Extent

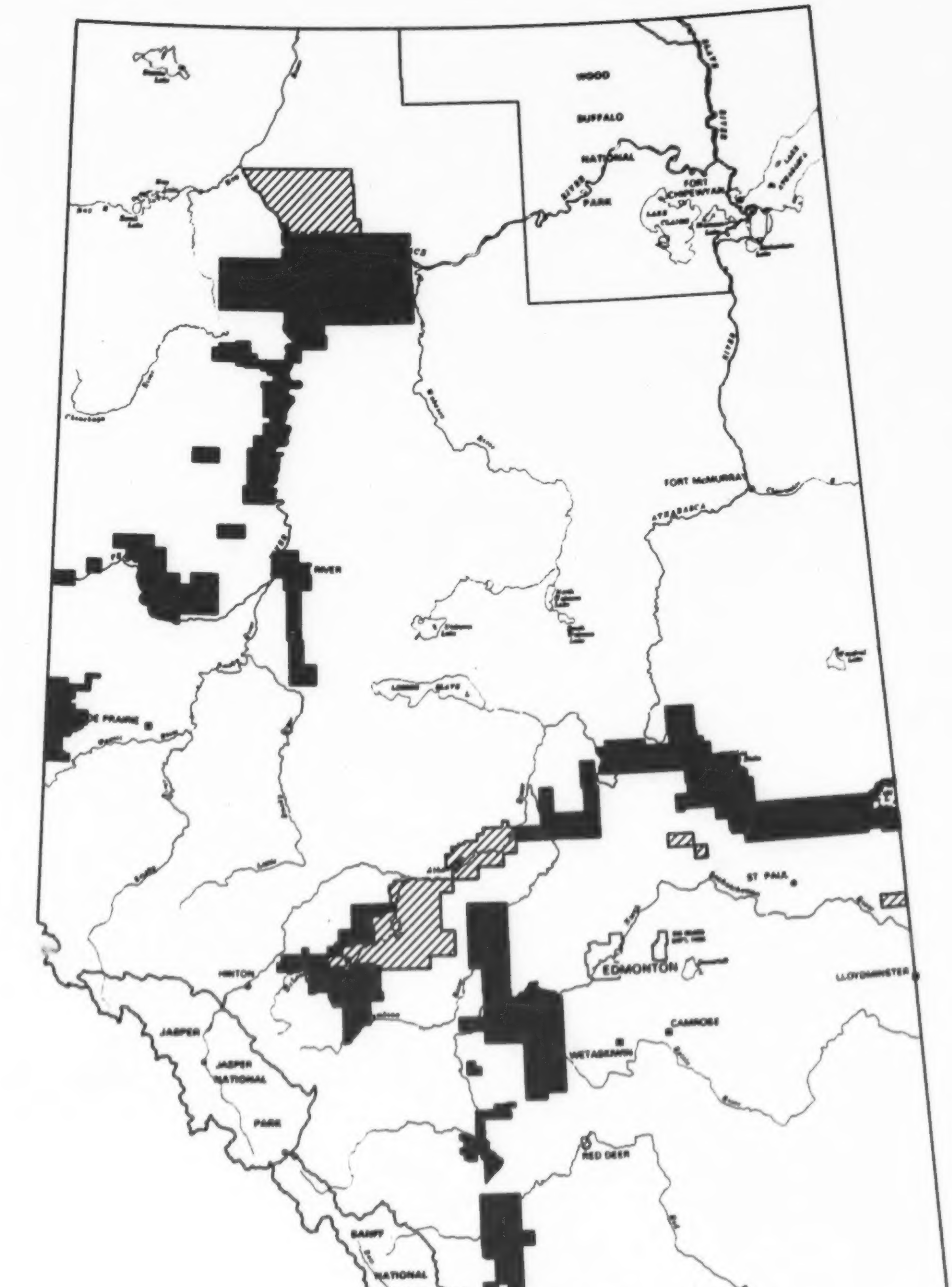
1	1-25%
2	26-50%
3	51-75%
4	76-94%
5	Entire

[5] **Vegetated Anthropogenic**
Except for agricultural lands, anthropogenic lands on which the native vegetation was initially altered by man likely was reseeded to cover crop (probably a mixture of grasses and forbes) that would be classified as CP or CPR. Gradually native species would invade until a "natural" cover type was re-established.

[6] Industrial areas use agricultural codes

FIGURE 3: ALBERTA VEGETATION INVENTORY PRIMARY CLASSIFICATION

Figure 4


WOOD
BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
FORT McMURRAY
ATHABASCA
PEACE RIVER
GRANDE PRAIRIE
ST PAUL
EDMONTON
LLOYDMINSTER
HINTON
JASPER
JASPER
NATIONAL
PARK
CAMROSE
WETASKIWIN
RED DEER
BANFF
NATIONAL
PARK
BANFF
CALGARY
MEDICINE HAT
LETHBRIDGE

ALBERTA VEGETATION INVENTORY PROJECT AREA

■ Completed Project Area

▨ To be Completed March 31, 1992

November 1991

GIS - A TOOL FOR CONSERVATION PLANNING

by
Hans Schreier and S. Brown
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ABSTRACT

For GIS to be successful the four key components: hardware, software, data and people all need to operate in a symbiotic manner. Once this is accomplished GIS will be an exciting integration tool that will facilitate resource management and conservation planning. Examples of GIS applications to conservation planning will be provided ranging from simple overlay techniques to linking GIS with models. GIS is an important tool in assisting the conflict resolution process and providing the basis for integration and decision support.

INTRODUCTION

Much has been written about the potential use of Geographic Information Systems (GIS) as a new tool to assist in the solution of our planning problems. Many expectations have yet to be fulfilled. Because of the very rapid advances in hardware, the complexity of software developments, problems with data integration, and a continuous increase in expectations, some users have been frustrated and have suggested that the GIS industry is in a state of chaos.

GIS enables us to process spatially referenced data in an automated manner and facilitating processing, analysis, and display of geo-referenced information. Many people believe that this technology will prove to be an ideal integration tool for environmental evaluation, conservation and land use planning.

Buying a computer and a GIS package is only the first step in the successful use of a GIS. Data and people have to be an integral part of the hardware/software system. Most of the difficulties in using GIS in conservation can be attributed to a lack of understanding in the environmental processes involved and to people's capacity or resistance to adjust to very rapid changes in technology. We do not like to deal with uncertainty and we are reluctant to embark in directions where the probability of success is low or cannot be measured in any objective manner. Only when we reach a state of crisis do we change direction.

A symbiotic relationship is needed between hardware, software, data and people and only then can we use GIS to its full capacity. Let us briefly consider the four components in isolation.

Computer hardware developments have been very rapid and the improvements in data storage capacity, processing speed, and flexibility have been dramatic. While it is difficult to cope with these rapid advancements, they are at least predictable. Our response has been to try to upgrade hardware on a 18-24 month basis. Investing in expensive upper end hardware is thus beyond reach for many organizations. Utilizing the lowest end hardware which will support organizational needs provides the best option. The current generation of 486 PC computers is often sufficient.

The development of software is more problematic because as the computer storage and processing capacity go up, so do users expectations. This means that software releases and upgrades are frequent. Unfortunately the learning curves for most GIS programs are still very steep. This means that much time is spent learning new software options, leaving little time to developing working GIS models. Software manufacturers illustrate options on a demonstration project but individual data sets often generate unique problems which need to be resolved. This situation is unlikely changing in the near future since advances in GPS, remote sensing and scanning are providing spatial data in a more rapid manner.

One of the most critical problems is the availability and reliability of spatial data. Much environmental data has been accumulated in digital data bases. Unfortunately most data are subject specific, the geo-reference system is poor or absent, the scale and intensity of the surveys inappropriate and the time of data acquisition impossible to discern. This is particularly severe in conservation planning where we have to rely on the integrated picture of many different sets of environmental data.

An alternative is to collect your own spatial data set for a study area, but this is a very costly and time consuming process. However, if you deal with very intensively used study areas a long term investment in generating a comprehensive GIS data base will pay dividends down the road. Also, the advances in GPS will certainly assist us in conducting more efficient field surveys that can readily be incorporated into a GIS data base.

In any GIS project a very large portion of the time has to be devoted to data base development and in many cases building and maintaining the data base is all people do. Only when we move to the stage of GIS data analysis and modelling can we use this technique to aid in the resolution of conflicts, develop a conservation plan, and improve resource management.

Finally, we need to retool resource professionals and make them GIS literate. We cannot accomplish a successful GIS planning process by depending entirely on computer specialists since they rarely have a good understanding of the data requirements, accuracy, data complexity and the environmental processes necessary to produce models for resource management. University students today will get the necessary training in GIS and resource management, but upon completion they will lack the experience necessary to develop successful conservation plans. For this reason we need to encourage the established professionals to become familiar with the GIS technology.

GIS is definitely a new and exciting integration tool that will facilitate the process of integrated resource management and conservation planning. We see this technique as providing the platform on which we can develop long term management plans, resolve conflicts, and provide resource management options in a rapid, and flexible manner. But this process will only work if all components work in a symbiotic manner.

EXAMPLES OF GIS APPLICATIONS

In environmental applications we usually have point, line and spatial information. Once each data set is geo-referenced we can start analyzing and displaying the data in novel and interactive manners using GIS techniques. A simple example is water quality and fish escapement data, which are collected at different stations within a river system. GIS buffering techniques allow the graphic display of point data by varying the size of the point proportional to the magnitude of pollution or the number of fish passing that point at any given time of the year. The resulting map thus provides a visual representation of where in the river system the pollution is highest and where the fish are most frequent. Given the dynamic nature of river water quality it is readily possible to produce a pollution map that changes from day to day and season to season. Rather than generating such daily pollution maps we can compare the pollution levels by using the overlay technique and produce a change map indicating where the pollution has increased or decreased over a given time interval. For example: Lead concentrations in bed sediments are displayed in Figure 1 for the 1973 and 1989 time periods and the results are summarized by displaying those stations where pollution has increased in a different symbol or colour from those where pollution has decreased (Schreier et al 1991).

Similar techniques can be applied to linear features such as roads and traffic intensity (number of cars per day), but the most effective use is in the quantification of spatial units such as land use, soils, surficial materials, vegetation, and economic and political units.

A good example of GIS use is the monitoring of land use change over time. Once the land use information for two or three successive dates have been incorporated into a GIS system it is readily possible to overlay the data sets and show the dynamic changes in a quantitative manner. In addition we can then query the data base and not only find out where some of the specific changes have taken place but what the possible causes for the changes are, how they affect other resources in the test area, and what the future implications of such changes could be.

More sophisticated GIS applications include combining point, line and spatial information and linking them to predictive models. An example of a successful GIS based soil conservation project is provided in Figure 2 showing a watershed study in the Peace River region (Burton et al. 1991). Here, soil and land cover information was collected in a spatially referenced manner. Within GIS the spatial distribution of % sand, % silt, % clay, % soil carbon, and depth of the Ap horizon was mapped and krieging techniques were used to convert the point data into iso-lines and spatial units. Topography and land cover was added to the GIS database and soil erodibility was calculated for each polygon within the watershed using a regression function based on particle size, organic matter and depth of the Ap horizon. The resulting combination map divided the watershed into units with different erosion risks to which slope, and land cover can be added as separate overlays. This not only allows for predicting the erosion risks within the watershed but by adding the crop cover data it is possible to indicate to the farmers which fields are under cropping systems that are inappropriate for the given risk group.

Probably the most interesting use of GIS is in the area of conflict resolution and scenario testing. Such applications are possible because GIS can assist in producing computer maps of different conditions and each option can then be evaluated and compared with reference to other options. Once a relational data base is compiled for a test area and essential planning models have been developed it is then possible to produce development or conservation scenarios for any polygon or the area as a whole. GIS provides disposable maps where we can produce and compare different scenarios, choose the best options, and develop a final plan. This can be done not only in an interactive way but with an integrated team of stakeholders.

GIS and its associated spatial data base can form the tool that facilitates interactions amongst multiple users. It thus becomes a new method of resolving conflicts where stakeholders can interact and present their case and different development plans can be compared in a very rapid manner. An example of this is conflict resolution between forest harvesting and wildlife habitat conservation. Using digital elevation data and forest cover information it is readily possible to develop a 100 year harvesting plan to maximize timber supply, maintain diversity and develop a planting program that assures resource sustainability. At the same time a wildlife habitat suitability evaluation can be carried out for Moose, Caribou, Bear etc. The habitat suitability evaluation can then be superimposed on the harvesting plan and the areas of conflict can then be highlighted.

Economic models linked to the data base will enable us to calculate the potential economic ramifications from avoiding the timber harvesting on wildlife habitat classified as highly suitable. Once wildlife managers have determined the carrying capacity of the suitable habitat, it is then possible to arrive at potential solutions that optimize forest harvesting and minimize habitat destruction. GIS techniques will allow us to develop a number of options that can be worked out between the interest groups and options and trade-offs can be compared in an efficient manner. A number of such case studies are currently under way in Alberta (Buckley et al. 1992, Leggat and Buckley, 1991), B.C. (Schreier et al., 1992), Oregon (Cimon, 1992) and Minnesota (Queen, 1992).

The next step is to enlarge the data base and to include tourism and other land users to arrive at comprehensive land use plans. As indicated by Dangermond (1992) it is in the area of conflict resolution where GIS is going to play a key role in helping us to better management of our resources.

CONCLUSIONS

The power of GIS technology is not necessarily in arriving at the best plan but at providing a platform for interaction, and for developing planning options in an open and flexible manner. GIS has the greatest attraction as a tool for decision support and it is particularly attractive in areas where there are many different land users and where the conventional planning process is impaired due to the complexity of interactions and the confrontational nature of many stake holders. GIS is a neutral tool that facilitates the planning process by being able to lay out different options in a rapid and quantitative manner. Once these are linked to economic models they become very powerful and a persuasive decision support tool. What is most appealing is that economic and non-economic considerations can be incorporated into the evaluation process which is vital if we want to arrive at sustainable use of our resources.

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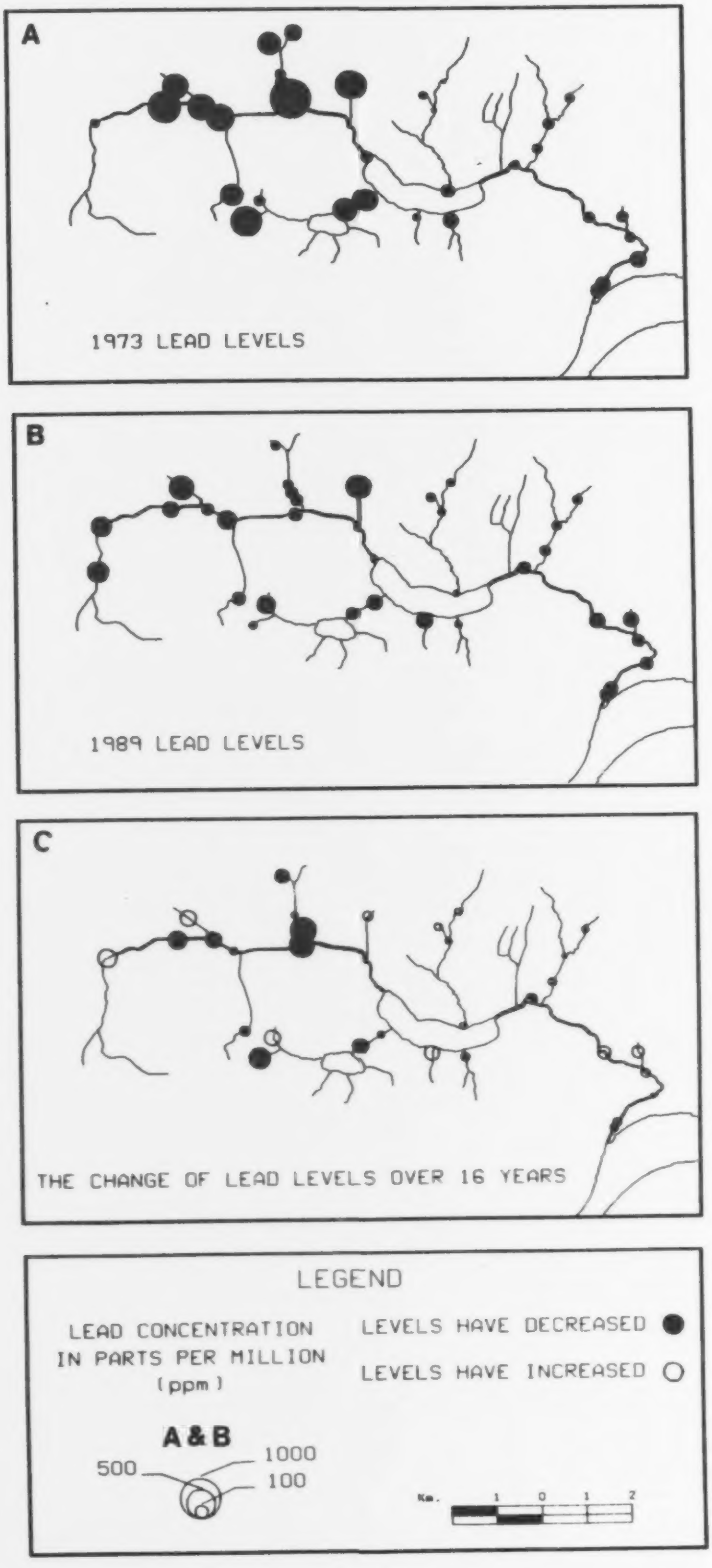
A
1973 LEAD LEVELS
B
1989 LEAD LEVELS
C
THE CHANGE OF LEAD LEVELS OVER 16 YEARS
LEGEND
LEAD CONCENTRATION IN PARTS PER MILLION (ppm)
A & B
500
1000
100
LEVELS HAVE DECREASED ●
LEVELS HAVE INCREASED ○
Km. 1 0 1 2

Figure 1. Metal pollution in bed sediments in the Brunette River Basin. A) Led concentration in 1973, B) Lead concentration in 1989, C) Changes in lead pollution over the 16 year time period.

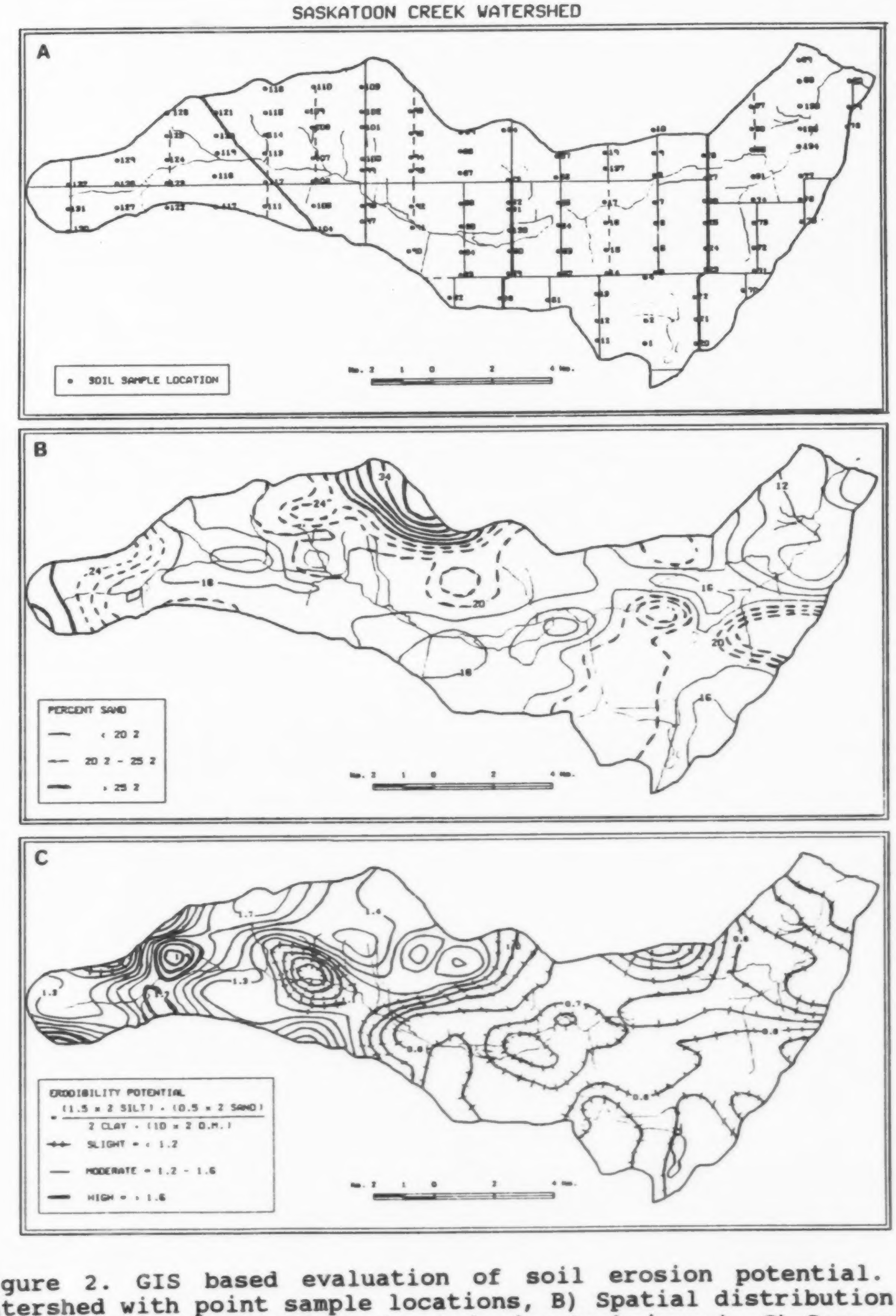
SASKATOON CREEK WATERSHED
A
SOIL SAMPLE LOCATION
B
PERCENT SAND
< 20 %
20 % - 25 %
> 25 %
24
34
18
20
16
12
C
ERODIBILITY POTENTIAL
= (1.5 x % SILT) + (0.5 x % SAND) / % CLAY + (10 x % O.M.)
SLIGHT = < 1.2
MODERATE = 1.2 - 1.6
HIGH = > 1.6
1.3
1.7
1.6
0.7
0.8
Km. 2
1
0
2
4 Km.

Figure 2. GIS based evaluation of soil erosion potential. A) watershed with point sample locations, B) Spatial distribution of sand content in the soil (using krieging techniques), C) Composite evaluation of soil erodibility potential based on a regression that includes particle size and organic matter content.

CONFERENCE SUMMARY

by
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INTRODUCTION

It was with some trepidation that I accepted the invitation to summarize the preceding days in a few paragraphs. There has been a great volume of information presented and I could not repeat all the specifics that have been covered. However, I came to the workshop with a list of questions and perceptions about conservation planning and, by way of summary, perhaps can consider these in the light of the past 2 days.

What changes have taken place in this area of conservation planning over the past 25 years?

> "It is our hope that the experience brought together here, will be helpful to those engaged in regional and community planning for the best possible use and conservation of our land resources."
> Pearson R.W., and L.A. Richards. 1966. From the Foreward to Soil Surveys and Land Use Planning. (L.J. Bartelli, A.A. Klingebiel, J.V. Baird and M.R. Heddleson editors). Publ. by the Soil Science Society of America and American Society of Agronomy.

The major changes from 1966 seem to include an expanded vision of the need for soil conservation planning down to the individual farm or field level, as well as at the more traditional regional or community levels. The change in emphasis also includes what I perceive to be a shift from a singular concern for the preservation of high quality agricultural lands from urban expansion, subdivision design, highway and airport location and construction, to include a concern for or to preserve, conserve, and/or restore all those soil-landscapes that we use for agricultural production, no matter what their quality. Perhaps we have reluctantly accepted the reality that non-agricultural land use is going to proceed, but I would hope that we have not given up the fight to maintain our options as to what that use should or will be.

The organizing committee for this workshop recognized that the scope of "conservation planning" was exceedingly large and some selections had to be made to accommodate the topic in a 2 day workshop. The issues involve both general policy discussion at a more general level, as well as actual implementation activities and individual farm perspectives. As the first of perhaps many workshops on this general theme, one has to begin somewhere and the selection was to begin with experiences to date upon which future activities may be built. The organizing committee were also cognizant of the double faced coin that was being tossed with the implementation of general policy also requiring some technical expertise. To this end a technical workshop on some of the tools available to assist with the development of conservation plans was held after the general workshop.

THE PROBLEM ON A PROVINCIAL SCALE

Are there any similarities across the provinces in terms of the nature and extent of the soil conservation problem, and in the programs in place with which to address them?

Representatives from various provinces outlined the nature and extent of their soil conservation problems and remedial programs. One of the things that struck me during their presentations was the diversity in the problems and/or areas of major concern:

- in British Columbia concerns include soil and general environmental pollution, soil compaction, urban expansion, and the problems brought on by the fact that the population is growing in relatively confined natural landscapes;
- on the great plains the problems relate less to limitations in the total areal extent of the landscapes available for agricultural production and more to control of wind and water erosion, salinity, and the maintenance, if not of high levels of production, at least of the potential for production;
- in Ontario problems relate closely to those in British Columbia along with the concern for nutrient loading into surface and sub-surface water supplies;
- in New Brunswick the problems addressed included soil compaction (as in parts of British Columbia), water erosion from potato fields, waste management and water pollution.

Perhaps the summary statement on the nature and extent of soil conservation problems lies in our realization that our past "industrial" approach to soil resources, especially those resources that are relatively inelastic when it comes to absorbing abuse, must come to an end. The natural balance of things, as precarious as it is, has been thrown off-center over the years and perhaps, if we can't get it back to the equilibrium of the center, we can at least work to begin to reverse the trend. The paper by Don Gayton (Planning Considerations for the Agricultural Landscape), in which reference was made to some loss of harmony with the natural landscape, illustrates the point.

ADDRESSING THE ISSUES

What resources are being assigned to the conservation planning effort?

I had some initial questions about the level of resources and the point(s) at which they may be aimed. While it seems that many conservation policies and programs are initiated at the top and slowly work their way down to the farm gate, there are many other programs that appear to have a more grass-roots beginning with groups, at the farm level, initiating their own programs and asking for resources to help carry them to fruition. I was impressed by the variety in the way in which all this takes place as explained in the presentations from the provincial representatives during the first session, the panel discussions on "Elements of a Successful Regional/Municipal Conservation Plan", and the second panel discussion on "What Do You Need for a Farm Conservation Plan". Most of the speakers stressed the need for sufficiently detailed and up-to-date soil and water inventory data to allow this planning process to continue at both the level of the region, where coordination must take place in a provincial context, and at the field level on an individual farm. It would appear that in most cases there is a very pro-active approach to problems on the part of all concerned.

It is true that bureaucrats are part of the problem in soil and water conservation planning?

One could make reference to the mountain of rules and regulations that seem to be in effect to govern everything that is going on in various provinces. Federal-Provincial agreements are one of the general class of positive programs that seem to be attracting considerable attention and are being used to support local and municipal initiatives. Ben Niemann presented a detailed account of the technology employed to face conservation issues in Wisconsin and David Pratt presented ideas on how the Soil Conservation Service assists farmers in the USA. Both mentioned that many of the things that are currently done for conservation planning sprang from certain government policies. At the municipal level, there could be a certain element of frustration in the process if conservation plans were to be short-circuited to satisfy some shorter-term political agenda. The idea also came through that as urban populations become "greener", there would be more support in the political arena for conservation efforts and planning.

SUCCESSFUL PLANNING

The panel discussion on the elements of successful regional/municipal conservation planning, illustrated the significant differences in the size, population density, and mix of urban and rural residents that constitute "municipalities" in different parts of Canada and the US. It is little wonder that each must devise a scheme for itself as there may not be many universal and easy recipes for success. All agreed that planning goals must be clearly defined, that sufficient inventory data must be acquired, and that the affected people must be included in the process. All in all, this was an interesting discussion of the major part of the planning process, but specifics of the final step in the process, that of plan evaluation, were not presented in the same detail.

At the session on "Planning at the Farm Level", the panel members mentioned the steps that are taken for a farm plan, but here too, is a place to put some quantitative evaluation procedures into place. It may be easier to study the economics of an individual farm than the economics of planning for an entire municipality. Paul Barlott was one who mentioned the need for sound economic analyses as plans are put into place and outcomes monitored.

How does one plan for down-stream effects?

Some of the speakers at this workshop expressed concern for, and the need to, consider the "boundaries of public interest" when it comes to the development of plans. To what extent do individuals have the right to do whatever they choose within their own fences, even though the consequences of their actions may be felt next door or many kilometers away? On the other hand we may find the situation where one individual develops and follows through on a conservation plan for their farm, only to be adversely affected by the actions of someone else, from 1 to 150 kilometers away, or the general municipality. While the discussion was interesting, there were no ready answers as almost every case would be considered to be unique.

What new technology is being employed for conservation farming?

During this workshop many speakers made reference to many machine-related technological advances in the area of farm conservation planning - computers and computer systems, specialized field equipment, etc. I was left wondering however, about the development and use of a variety of things in the area of bio-technology. If we can build a machine to assist with the solution to a problem, can we not "build" or breed specific plants that are more soil-friendly than many that we currently use for crop production? Instead of breeding for specific yield targets, yields that are attained at the expense of soil chemical and physical characteristics, could we not select for greater root mass, larger seed size, crop residues that would decompose to provide higher levels of appropriate organic material for humus formation, etc.? I also wonder about the need to farm by soil rather than by field. To this end, I am curious about the application of the latest geo-positioning technology and surveying techniques, coupled with computer maps and digital terrain models, to allow this.

Is the entire planning process being addressed?

During the workshop panel discussions, numerous estimates were made as to the proper number and kind of steps to be taken in the process of conservation planning. The number of steps reported ranged from 5 to 7,8, or 9. No matter how many steps it takes to define it, the planning process as discussed can be distilled down to involve, on both the physical side and the social side of the equation:

- a recognition or definition of the problem to be solved,
- an inventory of all the available resources (physical and social),
- an analysis of alternatives and their environmental and social consequences,
- a prescription of what is to be done and its implementation,
- an evaluation and critical assessment of the results.

Most of what I thought I heard at this workshop, in some great clarity of purpose, addressed the first three of the above, all on the physical side of the ledger. There were some questions from the floor about the proper critical evaluation of the effectiveness (economic or otherwise) of conservation planning. I would hope that at the Second Interprovincial Soil and Water Conservation Planning Workshop, we will hear of quantitative evaluation procedures being applied at the farm level as a test of the results. Finally I would hope that we can begin to consider and study in a scientific manner the social side, not just the economics or the public awareness, but the effect on the social structure of the home and the larger community. In his paper "Taking Human Resources into Consideration", Gary Runka covered the subject in detail.

HIDDEN ELEMENTS

In the final workshop session, items identified as "The Hidden Elements of Planning" were discussed. I would conclude from listening to the presentations that the need for detailed inventory data (soils, water, climate, vegetation, land cover/use) are as great today as in any time in the past. As our use of automated systems grows, our requirements for even more base-line data will grow too. It is time to recognize the true costs in time and money to develop and maintain the volumes of data expected to be used in the process. We must remember that if we tap into existing large databases, we may have to accept them, warts and all. There is going to be an increased need for the same kind of quality control/quality assurance procedures as there would be expected in any analytical chemistry laboratory.

At the end of the workshop I was reminded of the challenge issued to the participants at the beginning by Bob Forest, President of the Alberta Chapter, Soil and Water Conservation Society, that they accept the leadership role in this area. That challenge has already been accepted by many of the workshop participants. Perhaps they were to be counted amongst the "Hidden Elements" in the whole process, but their active participation has put their efforts into full light.

THE FUTURE OF CONSERVATION PLANNING

by
Bob Wettlaufer
Prairie Farm Rehabilitation Administration

Well, it is kind of difficult trying to be the wrap up speaker after a couple of days of very intense discussions and very interesting discussions. I was glad that Dr. Crown mentioned the Australian situation whereby the Australian farmers were taking matters into their own hands and forcing the bureaucrats; if you will, to look at their situation and starting to make things happen. I was fortunate enough to spend most of October in Australia and some of my comments about bottom up planning are going to come from the things I learned there. But of course when one's away one gets surprises and when I arrived back and was going through my mail I found a letter that said, "We are pleased that you have agreed to serve as a speaker for the Soil and Water Planning Workshop and here is your topic and here is what you have to do", signed Leon. I haven't found who agreed that I would do this on my behalf, but I will. But anyway, I am pleased to be here and to have this opportunity because as I say I picked some brains, I hope, in Australia and found a few things out that I hope we can apply and it largely relates to bottom up planning.

But being the last speaker is sort of a mixed blessing, first of all I have the last say of course, I have the last word but there aren't too many words left to be said. I started out when I left Regina with some notes, some ideas for things I wanted to say. I think I am on about my third rewrite. I told John I've got notes on my notes on my notes. So it will be interesting to see if we can find our way through this pile of scribbles I've got. But I guess what I have concluded at this point is more a reflection of what I've heard or a summation of what I've heard and what I think is important.

I was very interested in the panel discussions. I enjoyed them particularly. I enjoyed the addressing of the two questions, "What are the elements of a successful conservation plan?", that we heard yesterday and today "What do you need for a farm conservation plan?" They were very interesting. There is a broad cross-section of people here and a broad cross-section of people took part in those panel discussions. But when we are asking the question what do you need for a conservation plan, I think the person we've got to be asking that question of is the producer. We've got municipal representatives here and we have some producers here. But I don't think we've got nearly enough producers here. And when we get to seriously answering and seriously addressing those questions, I think we've got to get producers on those panels and ask those same questions of producers. One of the questions that we've been asking ourselves is "Why do we need farm planning?" or as a farmer might put it, "Why do I need a farm plan?" The conference brochure states, "Conservation planning, both regional, municipal and on farm is becoming recognized as an important tool for addressing sustainability issues in agriculture." and I guess the question that follows for me from that is "By whom is it becoming recognized as important?"

I'll relate a little story that was told to me by a participant here from Saskatchewan. The local ADD Board was having an auction to raise some money to do some of the things they wanted to do. They were auctioning off a number of things and one of the things they auctioned off was a farm plan. They got the local ag. reps and the various experts together and got them to agree to prepare a farm plan. So they auctioned off a farm plan. Nobody bid on it, nobody bought it. They could sell a PFRA hat for $20 more than they could sell a farm plan for. So I think we've got a little bit of a communication problem and people have alluded to a selling problem. So I think we've got to figure out by whom is this being recognized as important and it can't just be us.

I think we haven't finished our collective deliberations on what farm planning is or where we should go and this conference is certainly the most important and the first step in that process. But I think we or at least I, am coming to the conclusion that farm planning must be a way that we can provide the information that farmers are asking for in order for them to make informed decisions on how to best manage their landbase. And I want to stress two issues in that statement. The first is provision of information and the second is decision making. And I believe that farmers are very important in the first issue, provision of information. As far as decision making goes, they are the only people that are important. When we started out yesterday we were talking about planning and I was a little confused because we were talking about planning all over the map. We were talking about policy planning, program planning, on farm planning, what I am going to plant next year planning. I think it all came together for me when Bill Poole gave us two examples of planning. One was the municipal planning which was a complete bottom up municipal representative-lead planning process whereby the results came forward from the bottom with technical input where required. And the other example was with respect to the NAWMP which was a broad brush policy planning approach where it was a top down plan where broad targets were set. I think we've got to keep in mind that there are two approaches to this. A top down, a policy approach and a bottom up which is what I am going to plant next year approach.

We've been talking here about municipal and on farm planning and I had a bunch of notes on both but I just want to maybe talk for a few minutes about municipal planning. Because I didn't understand what it was for a long time and I am not sure that I still do, but when we've been talking about it internally people say well why do we want to do this? And from my perspective I think municipal planning has got to be a process whereby people involved at the municipal level can give some substance to their vision. John Kiss yesterday talked about a vision and I agree with that. But I think it is a way that they can look at their piece of land, piece of the world that they live in and say to themselves, what do we want this to look like in 10, 20, 30 or however many years? What kind of a place do we want to live in? If we want to break that down a little bit I think that involves goal setting where we can say what do we think is important; it involves setting priorities for action. Here is what we want to do and it involves some sort of framework for delivery. Those are the fancy words, but basically, how can we get it done?

I boiled some of my comments down into some planning principles and this is sort of a distillation of what I've heard although maybe put in my own context. I have come to the conclusion that there are four basic planning principles. Conservation planning is a process not a product. The producer is the planner. Individual planning must be carried out in a group setting, and the key to planning is integration.

Conservation planning is a process and not a product.

A number of speakers have noted that the results of a plan must be some sort of tangible result and I think that Peter Entz said that the results have to be demonstrable on the ground. If we end up with a paper plan or a paper exercise its no good. We've got to have results that actually happen on the ground. So in that regard, I guess land use change is a product. Land use change is a continual process. I think, and this may take issue with some of the things that some people have said with respect to GIS, but I think we maybe have to have a little less emphasis on some of the toys or the tools of the trade. I think they are excellent, I think they can help us with policy, I am not sure they can help the farmer with his planning. I'll relate a little story that happened to me in Australia.

I had spent a day in Sydney with the New South Wales Soil Conservation Service. After spending half a day in a boardroom, we went downstairs to look at their brand spanking new GIS system that they just spent 2 years and about 2 million dollars on. It was wonderful. They can do anything; they can produce maps. It was beautiful, I was blown away, I was impressed. And since the guy that was showing us around knew that we were going to Yass Valley in a couple of days, he showed us all the maps that he could produce of the Yass Valley and we looked at the Yass Valley six ways to Sunday. Two days later we are in Canberra and we are looking around just north of Canberra, the Yass Valley and we're driving around in the mud and the muck in the four wheel drive vehicle with the local DA and we're looking at his problems having a great day. About 6:30 we ended up in a little town in his office and we go into a complete clutter as all DA offices are, and on one wall its a huge aerial photograph, huge. There is grease pencil on it, there's thumb tacks, there's colored pins, there's ribbon, there's everything. It's a mess, it's a disaster. Over on the other wall there is the same GIS map that I saw in Sydney two days earlier. So we were talking to him about what he's doing and what he's keeping track of and then I said, I see you have a nice GIS map over there. What do you use it for? And he says "I just decorate the walls with it. I really use my aerial photo here, its right up to date. So I think we have to be careful when we are producing these tools and these toys, that they are really relevant and they are really useful for the people out there that are extending the information. If you go to the next level, the farmer, we have to be sure that it's useful for the farmer.

The producer is the planner.

Some of the things I heard, were people saying, "we plan this", and "we do this", and I think we have to be sure that we keep our focus on the producer and the producer being the planner. Gary Runka said that you have to involve the public early in the planning process. I guess I'd like to take that one step further and say if you don't involve the producer you don't have a planning process because the producer must be the planner. Producers don't want bureaucrats to tell them what to do. So, I think that it is very important that we keep that in mind. We talked about how do we sell this to producers and I wrote down three things and I don't know if that is all there is. I wrote down heart, head and wallet. I think we have to appeal to a producer's sense of conservation ethic, I think we have to provide the necessary technical information that he can make the proper decisions and I think that we've got to appeal to his wallet. Whether or not you choose to concentrate on economics, I really believe if the farmer can't make a buck he is not going to do it. I would suggest that the process has to create wealth, and I think we can measure that wealth either in terms of dollars or quality of life, however you wanted to find that.

On farm planning in a group setting

I think we all would love to be able to carry out on farm planning at the kitchen table on a one-on-one basis. But with 150-plus thousand farmers in western Canada, and our very limited personnel resources we just can't do it, it's impossible. So I think we've got to plan on the basis of groups and work with individuals in a group setting. And fostering groups, making groups work is something that we are not very good at yet. It would appear that groups form around some common focus, some common problem, be it waste management, be it an erosion problem, but I think we've got to learn how groups work and how groups can proceed to solve problems. I am going to come to this a little later.

A couple of advantages of groups is that they provide some feedback. Paul had talked about coffee row and I think that is something we should not overlook in terms of educating producers. One comment about the workshop, or the farm planning sessions, they are not one shot things, I think they are on-going things. I think a group will need as many workshops as it takes in order to gather the necessary information to solve their problems.

The key to planning is integration.

Dr. Hill talked at lunch yesterday about the need to integrate these environmental variables with social variables and economic variables as well. Dr. Schrier just recently told us about the use of GIS as an integrator and I like that definition and I like that use. That's probably where the strength lies. I thought I was really clever in coining a phrase about planning called whole farm planning rather than on farm planning but I think I heard it used about three times by previous speakers.

My topic I guess was what is the future of on farm planning. And to be frank with you I don't know. Early yesterday, John showed us his slide of the crystal ball so he has a crystal ball. I don't know. But here are some thoughts; I think planning in its broadest sense is a wave that is coming for better or for worse, it's coming. I think we better learn how to do it right, and we better learn that it is a people process and not a paper product. The kinds of sentiments that were expressed by John Kiss and Leon Marciak, I couldn't agree more with. People have to be the focus. We are currently thinking through Green Plan initiatives in the three prairie provinces and I think that planning will become an integral part of those new initiatives. We've talked about pilot projects, and there are quite a few pilot projects going on, or things that we call pilot planning projects. We've heard about Stettler, we've heard about Manitoba, we've got somethings going on in Saskatchewan. I am not sure that they are really on farm or municipal planning projects from the bottom up like the way we have to do them. I am not sure we've completed the process enough to know exactly what we are doing, so I think that in the future we've got to continue with the pilot approach. Maybe it's more of an evolutionary approach where we start slow and build and learn as we go, but I think we have to do that rather than mounting a full blown cross-all-provinces planning program.

Another major area that I think we have to improve upon is our insight in group formation, group skills and group facilitation. Gary Runka talked at length about that and I agree with him completely. We have most of the technical skills involved but we don't have the group skills involved. In Western Australia for example, all DA's and all staff of the Western Australia Department of Agriculture go through a three week group work course followed by a one week refresher course every year. And that was everybody from the assistant secretary on down. Not only has it improved their ability to work with farm groups, it's improved their ability to work with each other. I think we've got some lessons to learn there. In New South Wales where they have what they call communities of common concern and land care groups, they can get Commonwealth money and state money to hire group facilitators, sociologists, whatever they need to make their group work. They can also get money to hire the technical people they need, but they can access group work skill people and I think there is something here for us to learn.

I think we've got more to do on thinking through the process of getting the farmers involved, getting the farmers' commitment and getting the farmers' leadership. That might be academic, but I think we've got a lot of work to do there. We've got to define better what is needed by the farmer in order to prepare these plans; I talked about it earlier. But, farmers are asking for hard information. The questions we've got to ask ourselves are, "Do we know what that information is," and "Do we have it", and if we don't know the answers to either of those questions we have got to get it before we can be credible planners.

Another point that I think we've got to do, and this relates to the idea of pilots, I think we've got to start the process, we've got to provide some support and some encouragement, we've got to provide some care and feeding and let the farmers and municipalities go with it. I think Ian Dyson made the statement that this is a plan not a play. I like that. It's not scripted, we've got to let go of it, we've got to let the producers run where they want and provide them the support.

Finally, I think that municipalities have a very powerful tool called taxation. I don't think that we've explored that to the extent we could. Don Gayton made some reference to assessment and that system but I think there is lots of room to utilize the municipal taxation system to encourage changes in land use. I think we haven't explored it in the depth that we should.

Well that's just about all I wanted to say but I'd like to sort of distill all that into five basic points. If there is anything I would like you to remember, or there is anything that I think I have learned from these last two days is five points:

1. Planning is a people process, not a paper product.
2. The producer is the planner.
3. Individual planning must be carried out in a group session.
4. Pilots or evolution is the way to go.
5. Interaction is paramount. Single resource or single discipline focus will not work. We've got to integrate resources, disciplines, all affected individuals, and we have to integrate those environmental variables with social and economic aspirations.

Thanks a lot.

F3

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Computer Tools for Soil and Water Conservation

BACKGROUND

The Computer Tools for Soil and Water Conservation session naturally evolved from the First Interprovincial Soil and Water Conservation Planning Workshop. The idea was to have a pre or a post workshop course on some aspect of computers. The difficulty was in determining the subject matter itself and having the subject matter level meet a wide audience. From the organizers' perspective, selecting a course in a subject area that would meet everyone's needs was formidable. Therefore, it was decided that a day focussing on the presentation of a cross-section of various computer applications from the prairie provinces would be the best starting point. From this starting point the organization of the workshop went very smoothly, it seemed once the path was blazed the arrangements all fell together.

The objectives of this session were two-fold. One was to provide a forum where specific computer applications in soil and water conservation could be viewed and described. A significant component of the workshop was the "hands on" time that the session participants could enjoy with the owners of the individual systems. The other objective was to develop an informal network of people who develop and use computer software in this area. We feel that both objectives were met.

There was another objective which was not apparent at the time of the workshop. The objective still is and hopefully was, that there will be other sessions, workshops or just plain "get togethers" where people can discuss computer applications. This is important because we believe that both developers and users of the computer systems need to get together to understand what really is behind the technology and real world applications. The evaluation of responses and feedback from participants further reinforced this desire.

The same group of people who worked so hard on the Soil and Water Conservation Planning Workshop continued to set up the room for the Computer Tools for Soil and Water Conservation session. A heartfelt thanks to all who assisted in making this day a success.

Leon Marciak

Leon Marciak
Co-Chair

Tom.

Tom Goddard
Co-Chair

CANADIAN HIGHLY ERODIBLE LAND PLANNERS {CanHELP} FACT SHEET

CONTACTS

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MODEL OBJECTIVE

- ☆ to estimate wind and water erosion losses.
- ☆ to enable the selection of alternative conservation practices and compare relative differences with existing management practices.

MODEL COMPONENTS

- ☆ Soils database
- ☆ Wind erosion routine {WEQ}
- ☆ Water erosion routine {USLE}

MODEL OPERATION

There are essentially three data entry screens:

- ☆ "Define the Farm & Field" - used to enter land and landowners information andinput many of the variables used in wind and water erosion equations.
- ☆ Wind Erosion Worksheet - used to calculate residue cover throughout the specified rotation.
- ☆ Water Erosion Worksheet - used to provide an estimate of water erosion.

APPLICATIONS

- ☆ for detailed conservation planning
- ☆ to estimate potential erosion and to select suitable conservation practices
- ☆ to develop regional or district conservation guidelines or to target and allocate resources

USERS

- ☆ the program is intended for use primarily by professionals and technicians working together with farmers to develop conservation plans.
- ☆ universities and colleges to teach courses in soil management and conservation

HARDWARE REQUIREMENTS

- ☆ IBM, AT compatible with minimum 286 processor
- ☆ EGA or better graphics adaptor
- ☆ minimum 192 KB RAM

CanHELP

(Canadian Highly Erodible Land Planner)

Allen Eagle[1], Malcolm Black[2]

CanHELP (Canadian Highly Erodible Land Planner) is an MS DOS™ program designed to assist in the selection of erosion control practices during conservation planning. The program was developed primarily for detailed on-farm planning, but has been successfully employed in group planning sessions and can be used in the development of regional or district conservation plans. Documentation and program design are targeted to the Prairies but the program has the flexibility to be useful in other areas.

CanHELP employs the Wind Erosion Equation (WEQ) and the Universal Soil Loss Equation (USLE) to estimate potential erosion. It can be used to examine the potential effects of different rotations, tillage and conservation practices. The program has three modules: a soils database which can store information on input factors for the erosion equations for each soil series or association in a region; a report module which can be used to print the entire soil database, and to display and print selected information pertinent to a particular farm unit; and an erosion worksheet which can be used to estimate crop residues at the soil surface during the critical erosion period, estimate potential wind and water erosion, and output a report of worksheet calculations to file or to a printer.

CanHELP requires an understanding of soils, farming practices, mechanisms of erosion, the WEQ and the USLE, and of conservation planning methodologies. CanHELP is provided free of charge to interested parties in Canada for agricultural and teaching applications. The program was first released in 1990 and has been improved as a result of field experience. Version 2 of the program will be made available to users free of charge once the program has been debugged and the documentation completed.

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THE WIND EROSION EQUATION

The Wind Erosion Equation is the best available technology for the planning of soil conservation practices to reduce the wind erosion. In its present form the WEQ is the product of 30 years of research in Canada and the USA. The equation integrates the important factors affecting wind erosion and provides an estimate of long term average annual wind erosion from an area.

The WEQ is an empirical equation based on experimental data largely from wind tunnel studies and from limited field tests. Since extrapolation of wind tunnel data to field conditions is extremely difficult, the equation seeks only to estimate annual soil movement averaged over several years. An attempt has been made to use the WEQ to estimate wind erosion for periods of less than one year (Bondy, Lyles and Hayes, 1980). This method has not been substantiated by field experiments and has not been included in CanHELP.

Estimates using the WEQ can best be interpreted as relative estimates of soil movement from an area in question. Estimates of soil movement are not necessarily soil loss from a field. A large proportion of wind eroded soil is deposited within the same field and some may be returned to an eroded area if the wind changes. Appreciable wind erosion will result in sandblast, soil sorting, and loss of soil productivity.

Although the output from the WEQ implies an accuracy of soil erosion estimated to within 0.1 t/ac the complex nature of the wind erosion process dictates somewhat more uncertainty in the results. Nevertheless, experience in the USA has shown that estimates of erosion are precise enough to compare farm practices and thus develop conservation recommendations.

The Wind Erosion Equation is: $E = f(IKCLV)$

Where E is the estimated long term average annual soil movement in t/ac.
I is a soil erodibility index. It represents the potential annual wind erosion from a wide, unsheltered, level, smooth, uncrusted and loose soil at Garden City, Kansas.
K is a ridge roughness factor. It accommodates the effect of tillage implements.
C is a climatic factor which characterizes windspeed and surface soil moisture.
L is the unsheltered distance across a field along the direction of prevailing erosive winds.
V is a vegetative cover factor which considers the effect of surface residue in the reduction of wind erosion.

When using the equation, factors must be chosen which represent conditions when wind erosion is likely to occur. This is called the "critical period" for wind erosion. In Western Canada most wind erosion occurs during April or May. Spring winds are generally strong and surface cover is usually removed by tillage during seedbed preparation.

The equation is not a simple mathematical relationship and cannot be solved on a calculator. The I, K and C factors are multiplied together but the effects of L and V involve more complex functional relationships with the other factors. The WEQ uses imperial units only.

THE UNIVERSAL SOIL LOSS EQUATION

The USLE estimates long-term average annual soil erosion due to sheet and rill erosion from hillslopes as a result of summer precipitation. The equation integrates the effects of precipitation/runoff, soil erodibility, slope length and steepness, cropping practices, and erosion control practices to estimate the long-term average annual erosion for a crop rotation. The USLE was developed in the USA using the results of 50 years of experimentation; its primary use is to select suitable soil conservation practices.

The data used to develop the USLE contained little, if any, snowmelt data. Obviously this causes considerable uncertainty for its use in Canada. Attempts that have been made to adapt the USLE to handle snowmelt. At present none of these can be recommended. The implementation of conservation practices to control rainfall erosion provides some measure of control against snowmelt erosion.

Output from CanHELP reports erosion to the nearest 0.1 t/ac. The accuracy of estimates is somewhat less than this since the USLE has never been fully verified in Western Canada. Preliminary research in the Peace River Region (Van Vliet et al) and in Manitoba (Pauls and Shaykewich) suggests that the USLE is accurate to within an order of magnitude for erosion to summer precipitation. The data also indicate that the USLE is capable of successfully discriminating between different management practices. The USLE is therefore a useful tool for the development of conservation plans in Western Canada.

The USLE has been used as a basis for many more water erosion models (i.e. CREAMS, EPIC, MUSLE, ANSWERS). It is currently being revised in the USA. This revised model (RUSLE) may be further modified for use in Canada.

The USLE is:

$$A = R\ K\ L\ S\ C\ P$$

where:

A is the average annual soil erosion in t/ac
R is a rainfall and runoff factor
K is a soil erodibility factor
L is a slope length factor
S is a slope steepness factor
C is a cover and management factor
P is a support practice factor which accounts for the effects of special conservation practices on water erosion.

CanHELP SYSTEM OVERVIEW

The CanHELP program can be divided into three functional components:

DATABASES

Three databases require input from the conservation planner while others are provided on the CanHELP diskette. An office location and personnel database is created to reduce data entry. Secondly, a 'Farm Unit' legend is created. This printed database lists data pertaining to each farmer and his land which may comprise one or more soil types. The third and potentially the largest database is created to store data about the soils which are common to the planner's geographical region. The soils database links a soil ID number with soil and climatic properties required for soil loss calculations.

WORKSHEETS AND PRINTOUTS

There are two worksheets used in CanHELP. The first worksheet calculates soil losses due to wind erosion and the second by water erosion. For a planning scenario, data values are either chosen from 'popup menus' or from information included in the technical review section of the CanHELP Users Manual. Two different graphs can be viewed after the wind worksheet has been completed; graphs cannot be printed unless you have a screen capturing utility. The farm unit database, the soils database and the soil loss worksheet can be printed as reports.

The program operation is straightforward provided that the user understands the soil loss equations. The conservation planner should read the section which reviews the Soil Loss Equations before proceeding to use the CanHELP program.

HARDWARE AND SOFTWARE REQUIREMENTS

HARDWARE

CanHELP will operate on any IBM compatible computer. Computers with IBM, AT compatibility (80286 processors) will likely be the best systems for using the program.

The computer system must have an Enhanced Graphics Adapter (EGA or VGA) in order to display graphs and should have a 1.2 MB (5.25 inch) or 1.44 MB (3.5 inch) disk drive. A minimum of 192 KB of memory is also required. It is recommended that the program be installed on a hard drive, because the data storage requirements may exceed the capacity of a floppy disk. The system files and data files should be stored in the same disk directory.

LANDBASE FACTSHEET

Soil Information System

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MODEL OBJECTIVE

To supply soil resource information describing the soil and landscape properties of a selected parcel of land.

To provide electronic access to resource information presently stored in various databases.

MODEL COMPONENTS

A relational database system relating soil polygon information to individual quarter section land locations providing soil resource information.

A simple yield prediction module, utilizing soil texture and probability of precipitation during the growing season, to determine possible yields for four (4) different crops.

A module to make general soil conservation recommendations based on soil zone, soil texture, landscape, slope and erosion susceptibility.

A module to export soils information essential for the operation of the CanHELP program.

MODEL OPERATION

Selection of data may occur by either 1/4 section legal location or the soil polygon number from the accompanying soils map. Data may be viewed on screen, or printed as a complete data set or individual categories. Data may also be exported to the CanHELP program.

APPLICATIONS

- Farm management, property purchases
- Land transfer appraisal
- Soil conservation planning
- Land appraisal
- Extension and planning
- Save our Soils Program
- Wildlife habitat studies
- Loan approval and land appraisal
- Service to farmers
- Lease rates and land evaluation
- Irrigation evaluation studies
- Research and extension

USERS

- Farmers, private consultants, university
- Revenue Canada, financial institutions
- PFRA
- Sask Agriculture + Food
- Canadian Wildlife Service, Ducks Unlimited
- Rural municipalities
- Fertilizer companies
- Saskatchewan Water Corporation
- ADD Board Technicians

HARDWARE REQUIREMENTS

IBM or 100% compatible with a minimum 512K RAM and 1 disk drive, running DOS 2.01 or greater. Hard disk installation and 640K RAM is a recommended configuration.

LANDBASE

Soil Information System

by
Henry de Gooijer
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The LANDBASE Soil Information System, developed by the Saskatchewan Soil Survey at the University of Saskatchewan, is an initiative to expand the use of soils information, by existing and potential users, through the use of computers. LANDBASE provides more than just soils information by integrating landscape, productivity and conservation information to provide a description of the soil and landscape resource.

The LANDBASE program is simply a collection of computer code or programs which allow controlled access to a set of databases containing soils and landscape information collected by the Soil Survey and various other agencies. By relating these databases, the information system supplies a comprehensive information package to a user for a specified area or location.

WHY WAS THE LANDBASE SYSTEM DEVELOPED?

An electronic format of data release was desired in order to diversify the type of soil products available to users and potential users. The Soil Survey handles all soil information electronically. Soil maps are digitized into a Geographic Information System, and all soil maps and reports are derived directly from these electronic sources.

A greater number of requests have also been received for data in an electronic format. These requests may be for digital map files or for databases of attribute data. Unfortunately the attribute data is highly symbolized and requires definition through accompanying legends and many individuals requiring soils information do not have access to GIS to allow them to access digital maps. LANDBASE was developed to allow access to the soil attribute data, linked to legal locations, complete with legends, without requiring a high end computer or extensive computer skills.

Initially the LANDBASE program only linked soil attribute data to soil polygons. Consultation with clients indicated that access to data by legal location was a necessity. Development work was initiated to develop a database which would link quarter section locations to soil polygons on an RM basis. Once completed for a Rural Municipality, data could be accessed by legal location. It was also then possible to access other land related information which was stored on a legal location basis, including assessment data and crop insurance data.

In developing the LANDBASE software, a set of guidelines were incorporated to facilitate development work. The program was to be menu driven, with context sensitive on line help, simple documentation and be compatible with IBM or 100 percent compatible computers. The software should be portable and compatible with a minimum of hardware requirements. The software should be compiled, eliminating the requirement for extra software purchases to run the program. A print feature was also seen as an integral part of the program.

HOW THE SYSTEM WORKS

LANDBASE is based on 1:100,000 scale Soil Survey maps and reports. No enhancements are made to the original scale of the data. Therefore when accessing information via the quarter section it must be remembered that the Soil Survey data being accessed relates to the polygon in which the quarter section occurs and not specifically to the quarter section. Only the Assessment and Crop Insurance data apply specifically to the quarter section. The actual quarter section database provides a link between the various databases, and not factual data about the location. A series of relational databases contain the source information or 'raw' data which characterizes soil polygons or specific locations. Another series of databases serve as 'lookup' files supplying definitions for the various symbols in the attribute data.

Soil data is represented on conventional maps with symbols, colours or hatching. These symbols or colors are then defined by adjoining legends. This is not only true for soil maps, but for many maps such as highway or grid road maps. LANDBASE automates the definition process associated with obtaining information from a map. When a soil area or legal location is requested, all soil data symbols associated with that particular request are compiled and defined. Where a map will supply a symbol, for example, CL on a texture map, LANDBASE returns the symbol, CL, plus the definition of CL which is clay loam. The advantages of this feature become much more evident when defining more complex symbols such as agricultural capability, salinity or soil map units.

LANDBASE information is centered around the soil and landscape information collected by the Soil Survey. Soil Survey information presented and defined by LANDBASE includes:

1. The Soil Map unit and description of soils
2. Agricultural Capability Ratings
3. Salinity
4. Landscape features (% slope, landform, slope lengths)
5. Surface Textures
6. Surface pH
7. Wind and Water Erosion Susceptibility
8. Organic Matter Ratings (Provincial Averages)
9. Wetlands Ratings

A series of general conservation notes and recommendations are generated from this data. These recommendations are for the province as a whole and represent a full listing of possible conservation practices based upon the soil zone, texture, slopes, soil pH, salinity, landscape, and erosion susceptibility. Farmers and agrologists may then use this list to pick appropriate conservation practices.

Subsets of data are drawn from the larger data files of various agencies in Saskatchewan with the goal of accurately presenting the land and soil resource at a particular location. Land assessment information, from the Saskatchewan Assessment Management Agency (SAMA) supplies land use information, acreage data, and productivity ratings for individual quarter sections.

Crop Insurance information, from the Canada-Saskatchewan Crop Insurance Corporation, provides quarter section ratings on soil productivity. A scale of ratings, letters A to P, are used to rate soils within 23 Risk areas or Climate zones in the province. Associated with these quarter section ratings is 15 year average yield information (actual and calculated), providing yield data for different crops.

Probability of precipitation data, derived from Environment Canada climate data, is utilized in a simple soil texture based productivity model to determine possible crop yields based on available moisture.

SYSTEM OPERATIONS

A program disk contains the actual LANDBASE software. This disk is compatible with all LANDBASE data sets. These data sets are organized on an RM basis to facilitate distribution and management of the data. The RM number must be initially selected to access information. Once the RM parameter is established, the choice of gathering information by quarter section or soil area is made. On screen messages and prompts validate selections and give messages as to the status of program operations. Once the entire data set has been compiled and defined, it may be viewed on the screen or sent to the printer.

LANDBASE also contains options to do a limited number of simple queries as well as export data to the CanHELP program developed by the PFRA.

AVAILABILITY

Coverage of the LANDBASE program now extends over 25 million acres or 120 Rural Municipalities in Saskatchewan. These areas generally correspond to the areas most recently mapped by the Soil Survey. In addition, another 40 RMs are presently being prepared for the LANDBASE system.

APPLICATIONS AND USERS

LANDBASE is presently utilized by a variety of agencies and individuals including farmers, PFRA, private consultants, Sask. Ag and Food, ADD Board Technicians, Wildlife agencies, financial institutions, Rural Municipalities, fertilizer companies, Saskatchewan Water Corporation and the University of Saskatchewan. Users of the data include farm management, property purchases, land transfer and land appraisal, extension, research, planning, lease rate calculations, wildlife habitat studies and irrigation evaluation studies.

FUTURE DIRECTIONS

A second writing of the LANDBASE program is now being planned. Users have indicated that a greater amount of flexibility is required in certain areas of program operation. At present, a new version of LANDBASE will try to incorporate the following concerns:

1. File saving and loading options
2. Regional versus provincial conservation recommendations
3. Increased query capabilities
4. A new CANHELP access module to access CanHELPII
5. Updated information for assessment, crop insurance, and climate.
6. A module option which would allow modules to be added for individual users with specific needs.

HARDWARE REQUIREMENTS

LANDBASE is designed to run on all IBM or 100% compatible computers operating on DOS 2.0 or above with at least 512K RAM and 1 disk drive. Hard disk installation is not required but is recommended. Installation requires approximately 275K of disk space per Rural Municipality.

FDA FACTSHEET

(Fertilizer Decision Analysis)

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MODEL OBJECTIVE

This interactive "expert system" type of computer program is designed to assist producers and agronomists with fertilizer recommendations.

MODEL COMPONENTS

- ☆ availability, cost, form and nutrient analysis of various fertilizers
- ☆ crop prices
- ☆ effect of application method on the efficiency of the nutrients and possible toxicity problems
- ☆ soil type
- ☆ soil test results
- ☆ soil moisture levels at planting
- ☆ management factors including existing equipment, financial resources and overall yield goals of the producer

MODEL OPERATION

- ☆ enter soil test results, prices, soil moisture, etc.
- ☆ calculation
- ☆ select output

APPLICATIONS

- ☆ recommendations for N, P, K and S fertilizers for most annual crops

USERS

- ☆ producers, agronomists

HARDWARE REQUIREMENTS

- ☆ IBM or compatible
- ☆ 8088 or 8086 or higher
- ☆ 640K of memory
- ☆ hard disk

A New Approach to Using Microcomputers for Fertilizer Decisions*

Farmers face a wide range of options when making fertilization decisions. The "ideal" source of fertilizer and the "best" rate, method and time of its application varies with a large number of factors including:

- availability, cost, form and nutrient analysis of various fertilizers
- crop prices
- the effect of method, cost and time of fertilizer application method on the efficiency of added nutrients and possible toxicity problems
- soil type, including texture and pH
- concentration of nutrients already in the soil (ie. soil test results)
- topsoil and subsoil moisture content at planting
- regional climatic conditions, including expected growing season rainfall
- the client's individual circumstances with respect to existing equipment, tillage practices, financial resources, safety preferences, overall yield goals and management ability, etc.

It is difficult to consider all of the options available and arrive at the "best" fertilizer recommendation, keeping track of all the variables mentioned above. Soil testing information provides a sound foundation for agronomists to provide better recommendations to farmers. However, there are still many factors which require a more individual, timely and interactive approach in order to tailor a fertilizer recommendation to a farmer's specific circumstances.

Soil scientists in Manitoba Agriculture and the Faculty of Agriculture are working with the Department of Computer Science at the University of Manitoba to develop an interactive, "expert system" type of computer program designed to assist producers and agronomists with fertilizer recommendations. "Expert" computer systems are designed to imitate human experts, using their skill and knowledge to develop a series of rules that apply only the most relevant factors to the decision-making process. By proceeding rule by rule and screening out irrelevant data or information, this type of program is much faster to operate and easier to change or explain, compared to most conventional computer programs.

Initial work on this research project has produced a prototype fertilizer selection program for IBM-compatible personal computers. The attributes of the U of M Fertilization Expert System Prototype include:

1. **Flexibility** - Crop yield goals can be adjusted for changes in:

    - price of grain, eg. higher grain prices encourage higher yield goals
    - price of different fertilizer compounds, matching yield goal to changes in fertilizer cost, eg. anhydrous ammonia is often the cheapest form of N, followed by urea, UAN solution and ammonium nitrate; fall and spring prices are compared.
    - cost and efficiency for different application methods, eg. banding is usually regarded as more expensive than broadcast or seed placed; efficiencies of fall vs spring application are compared; interactions of yield goal, soil N and application method may be considered if, for example, a modest rate of N with the seed may be more profitable than investing in a separate application method for applying a higher rate.
    - moisture regime, eg. moving from ideal to moist, dry or arid categories

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* Summary of presentation to Manitoba Soil Fertility Advisory Committee, October 24/91

2. **Detail** - Specific characteristics of the client and field are focused on, for:

   - avoidance of toxicity damage from seed row placement, eg. applying urea under dry conditions or where soil texture is coarse
   - increased tolerance for seed row placed fertilizer where possible, eg. applying N fertilizers into moist, fine textured soils using an implement which separates or scatters the seed and the fertilizer
   - net economic efficiency of the application method, eg. fall less efficient than spring, from the perspective of N efficiency, only, not necessarily after cost difference is considered.

3. **Speed** - The program is designed to ignore irrelevant information:

   - gives the farmer quick results, eg. reduces many fertilizer cost curves or tables to the one describing the least cost alternative for a given level of nitrogen supply

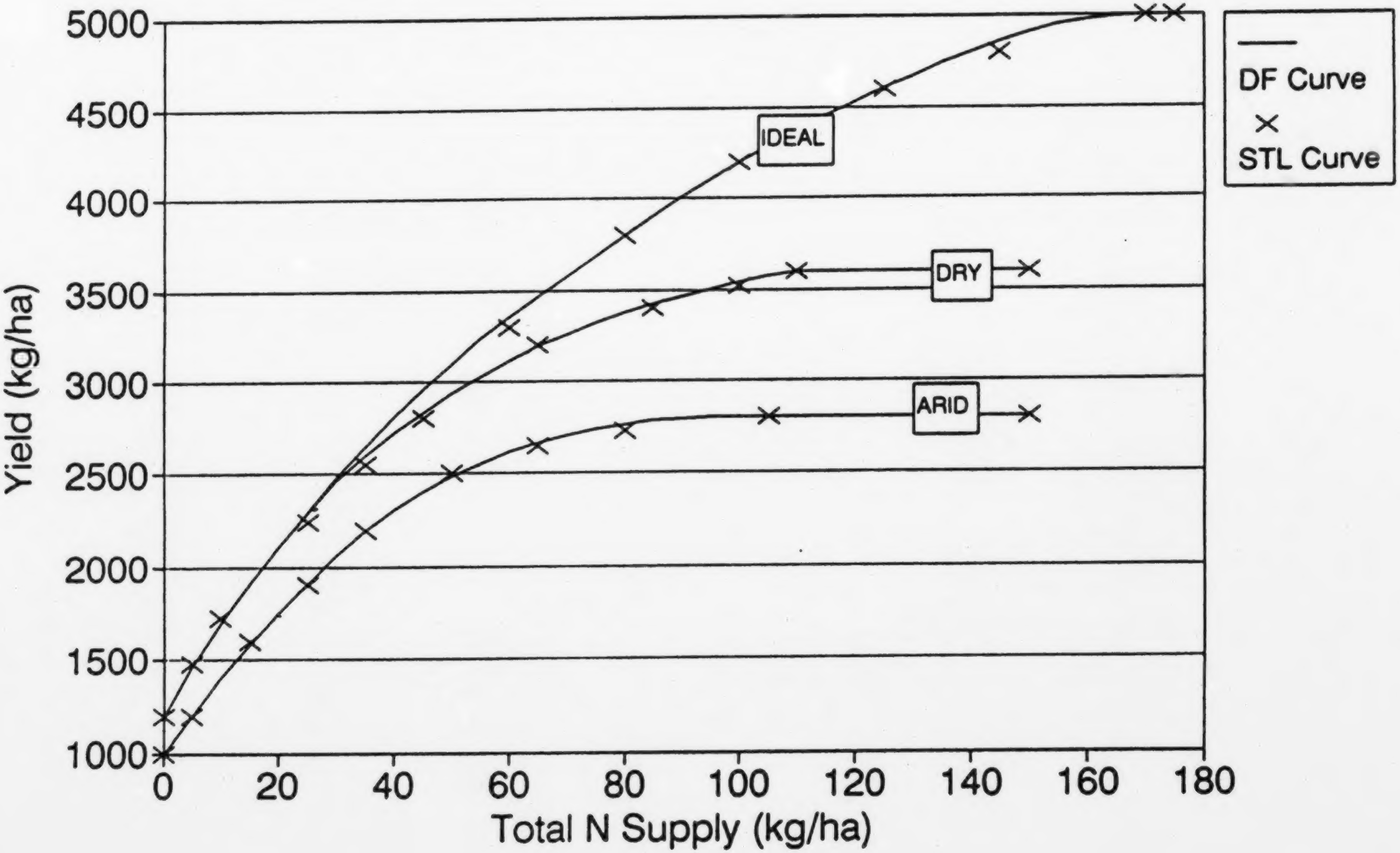
4. **Ease of Use** - The expert system programming technique allows:

   - "telescopic vision", allowing the user to focus in on detailed calculations and explanations _if_ the information is relevant or he or she is so inclined; makes much use of standard or default values, but allows for input of client's figures.
   - easy comparison and explanation of a variety of scenarios
   - easy, efficient development and updating of the program, itself, eg. correction of errors plus changes or additions to the "rules", default values, yield curves, addition of more modules, etc.

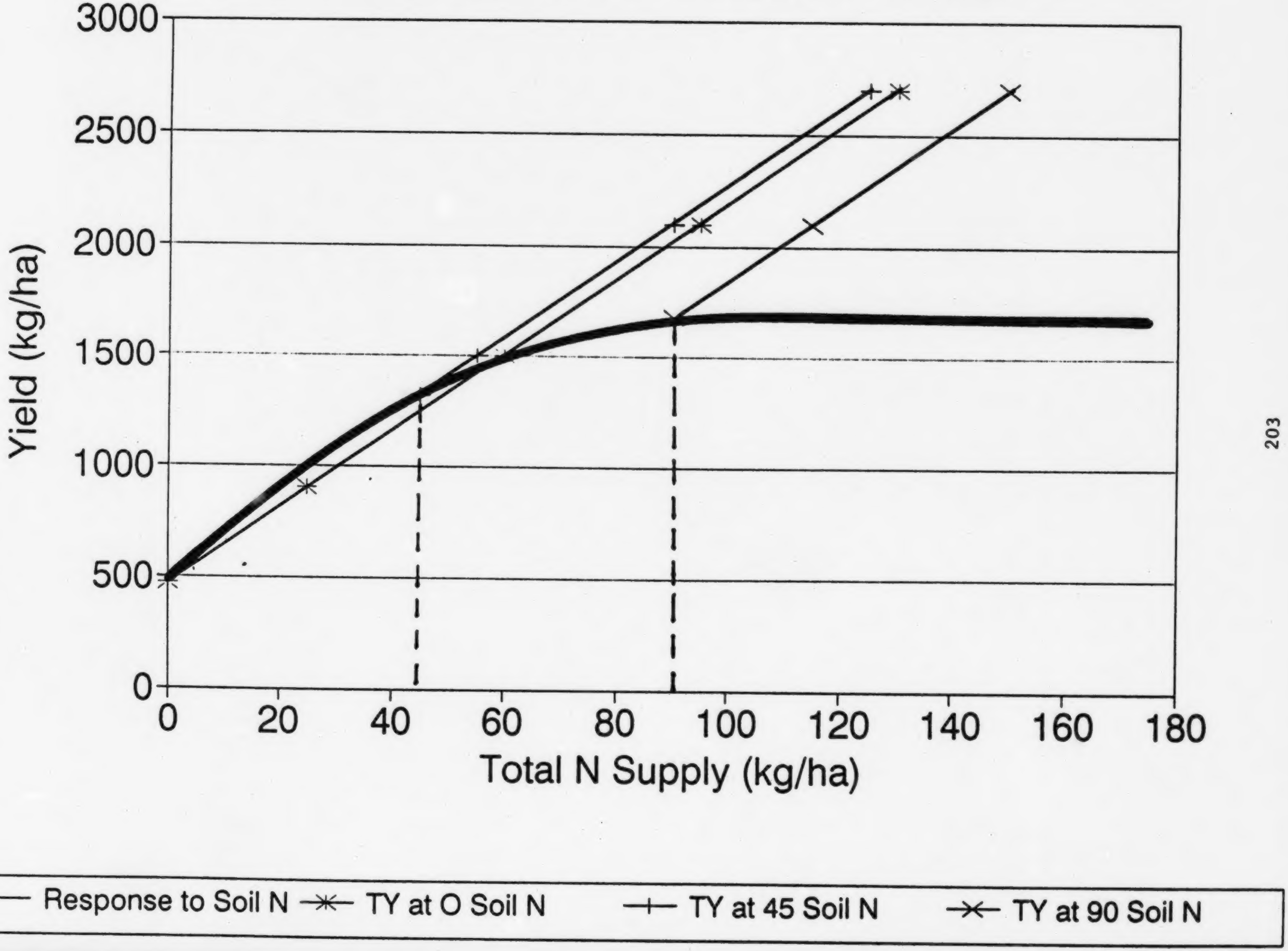
At present, the research prototype is restricted to wheat and barley, and provides recommendations for N, P, K and S fertilizers only. However, the scope of the program is in the process of being expanded to include other crops and nutrients.

For more information about the program, contact John Ewanek, Manitoba Agriculture.

EFFECT OF N ON BARLEY YIELD



EFFECT OF N ON CANOLA YIELD



CROP ROTATION PLANNER FACTSHEET

CONTACTS

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MODEL OBJECTIVE

To provide crop rotation analysis information to farmers and agrologists, based on the crops grown over a four year period.

To provide basic crop rotation information in an easy to access format.

MODEL COMPONENTS

The Crop Rotation module operates on a database containing information on 26 common field crops. This database is mainly comprised of data from the Manitoba Agriculture Crop Rotation planner wall chart, and updated with more recent Saskatchewan Information.

General Information modules supply data on crop rotations and information references.

MODEL OPERATION

Information on plant diseases, herbicide residues, weed problems and fertility concerns for the current crop year can be obtained by selecting a crop for the present year and indicating which crops were grown in the three previous years. Information obtained may be viewed on screen or printed by specific category.

Basic crop rotation information may also be viewed or printed.

APPLICATIONS

The Crop Rotation plannner may be used by farmers and Agrologists to determine the best possible cropping options to minimize plant disease and residue problems in a rotation.

USERS

Intended for use by farmers, extension personnel, conservation planners.

HARDWARE REQUIREMENTS

IBM or 100% compatible with a minimum of 640K RAM, running DOS 3.1 or above. The program must be installed on a hard disk.

Available on 3.5 or 5.25 inch disks.

CROP ROTATION PLANNER FOR SASKATCHEWAN

by
Henry C. de Gooijer
20-20 Agricultural Services
and
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Saskatchewan Rural Development

INTRODUCTION

Agriculture in Saskatchewan has been undergoing changes and adjustments in attempts to supply adequate income to farm operators. Farmers are adopting new cropping practices in order to diversify their farm operations, maintain income levels and expand into new product markets. Farmers often face new crops and cropping practices, new herbicides, and new soil considerations as they experiment with and utilize new crop rotations.

Unfortunately, these new rotations often present production problems which farmers have not previously faced or are unfamiliar with. Crops grown and chemicals used in previous years may affect management decisions for years to come. Agrologists and farmers require a quick and simple methods of checking for cropping options depending upon previously grown crops, herbicides applied, weed problems and soil conservation and fertility concerns.

Personal computers provide an excellent vehicle in which to extend production information to farmers. With the number of farm operators utilizing computers increasing, more and more information may be provided in the electronic format. Numerous farm accounting packages are available for farmers to choose from. These programs may be used to provide the farmer with an economic analysis of their farming operation. The number of software packages providing agronomic analysis however, is relatively small. The Crop Rotation Planner represents software which does provide such analysis for cropping sequences.

PROJECT DESIGN

The development of the Crop Rotation Planner may be categorized into three specific areas.

a) Data collection and data entry.
b) Software design and computer programming.
c) Technical content examination.

a) Data Collection

The major source of information upon which the program was based is the Crop Rotation wall chart as produced by Manitoba Agriculture. The chart contains codes which supply data on herbicide residue, plant diseases, problem weeds, soil fertility and conservation reminders for various crop rotation combinations. This information was entered into a database structure designed to accommodate this type of information. New herbicide registrations have occurred or changed since the last publication of the rotation wall chart, the publication Weed Control Guide for Cereal and Forage Crops in Saskatchewan was used to update herbicide information. Recropping intervals were changed in some instances to reflect the recommended practices in Saskatchewan.

b) Computer Programming

The design of the computer program required to access the information was developed with the following principles in mind.

The program should be simple to understand and operate. The level of computer expertise varies greatly among farmers and agrologists. Because of this, a balance must be struck between capability and operability. To effect this, the main functions of the program are entirely menu driven. Typing is only required for limited functions in the program.

The Rotation Planner should be portable and not require the purchase of other software in order to operate. The Planner is compiled dbase code and therefore does not require the purchase of any database or spreadsheet software to operate. This allows the software to be purchased and operated with a minimum of cost.

The software was also designed to be compatible with the most common computer hardware in use. The Planner will operate on all IBM or 100 percent compatible computers. This represents approximately 85 to 95 percent of farm computers operating today and the type of hardware being utilized by Extension Agrologists.

The type and form of output available from the software is also important. It was critical that the software would be able to produce information printouts which could be distributed to farmers or used in individual field files for future reference.

The continued support of the software was also a concern. In order for such a program to be useful, it must reflect the current database of knowledge in this particular area within the limits of the program. To facilitate this, literary searches are being conducted for various sources of information which will strengthen and present the current level of knowledge at this time. As the database of this knowledge increases, the software will be updated to allow access to this information.

Farmers and Agrologists have not been conditioned to the use of computer software for analysis of agronomic practices. In order to facilitate the use of such software, the price was required to be enticing. To this end, the software has been made as affordable as possible for as wide a range of individuals as possible.

c) Technical Content Examination

It is a priority that the information being presented by the Planner be technically accurate and applicable to Saskatchewan conditions. To this end, literary searches are conducted to bring forth the data required to keep the Planner current. Rural Development staff have also supplied technical expertise in recommending changes which suit the Saskatchewan condition.

The Planner, in its present form, is limited in its ability to accurately reflect the extent of problems or concerns which may occur in any one field. With the cropping sequence as the only variable input, the Planner will present a probable scenario for the crop being grown. The actual existence of the problem and its severity may greatly depend upon the farmer's management, regional climatic conditions and weather conditions within any one year, crop varieties, and rates of herbicide application.

SOFTWARE OPERATIONS

The Rotation Planner relies on an internal data set to determine possible cropping problems between crops. All information within the Planner is related to these crops. Therefore information selected is accessed by selecting crop names. The 26 crops presently stored within the Planner include Alfalfa, Barley, Buckwheat, Canary Seed, Canola, Canola (Triazine Tolerant), Corn, Faba Beans, Fall Rye, Field Beans, Field Peas, Flax, Forage Grasses, Lentils, Mustard, Oats, Potatoes, Soybeans, Spring Rye, Sugar Beets, Summerfallow, Sunflowers, Sweet Clover, Triticale, Wheat and Winter wheat.

By selecting 2 to 4 year rotation sequences of these crops, the program displays what may be agronomic concerns. The present crop or most recent crop, is the crop which is analyzed for possible production concerns.

When considers production concerns in the following areas:

1) Plant disease
2) Herbicide residues
3) Fertility concerns
4) Problem weeds

For any of the categories above, the program assumes that a particular problem may exist or residue may be present based on the possibility that the herbicide may have been applied, the disease may exist or the problem weed may exist in that type of rotation. It is the responsibility of the user to determine if the herbicide was actually applied in the previous crop or if the climatic conditions were conducive to disease development.

Plant diseases presently listed within the Planner include Ascochyta blight, Bacterial Blight, Blackleg, Black stem, Cyst Nematodes, Corn Smut, Damping off, Downy mildew, Early Blight, Ergot, Head Blight, Leaf Spot, Net Blotch, Pasmo, Powdery Mildew, Root Rot, Rust, Spot Blotch, Sclerotinia disease, Septoria leaf and glume blotch, Snow mould, Seed Piece Decay, Stalk rot, Tan Spot, Verticillium Wilt, and White Rust.

Herbicides which are checked for residual effects are Ally, Atrazine, Avadex BW, Bladex, Glean, Laddok, Lexone, Lontrel, Princep, Primextra, Sencor, Sinbar, Tordon 202C, Trifluralin, Edge, Fortress, Velpar, Assert and Muster.

The Planner deals with fertility and problem weeds in a much less comprehensive manner than with the disease and residue concerns. This relates directly to the amount of base information supplied within the Manitoba wall chart. It in no way indicates a lack of importance in these areas. These areas do however require considerable effort in building suitable databases in order for these topics to be treated more comprehensively.

Weeds are defined as problems by the Planner when the cropping sequence does not allow for the effective control of the weed in the crop to be grown. Weeds included in the Planner are Perennial Thistles, Mustard and Volunteer Crops.

Fertility concerns deal mainly with the growing of a cereal crop after a legume or root crop.

The Planner will display, on screen, all possible concerns for a particular rotation. These concerns are categorized by residue, disease, weed or fertility grouping. Each concern under the grouping displays the concern name (ie. disease or herbicide name), the risk factor involved with the concern, the previous crop relating to the concern, and a description of the problem. This information may be viewed on screen, printed or saved to a file.

TECHNICAL SPECIFICATIONS

The Rotation Program is a compiled dbase program written in the Clipper dialect. The program will run on all IBM or 100% compatible computers with a minimum of 640K RAM. The program must be installed onto a hard disk in order to operate. The program is available on 3.5 or 5.25 inch disks.

FUTURE DIRECTIONS

The future development of the Rotation Planner will depend greatly upon the feedback and input of ideas by the users of the program. The ability to analyze field records from an existing field record keeping system or to include a new field record keeping system are examples of suggestions being considered at this time. The inclusion of insect problem analysis and soil conservation recommendations are also being considered. Crop interaction between sequentially grown crops is being evaluated at this time.

Economics have been suggested as a possible addition to the Planner, however, with the availability of quality Economic analysis software on the market, this role may be left to economic analysis software and leave the Rotation Planner dedicated to agronomic factor analysis.

WSIS FACTSHEET

(Warner Soil Information System)

CONTACTS

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MODEL OBJECTIVE

To facilitate county wide and farm scale conservation planning in the County of Warner by providing computer access to tabular soils information registered to quarter section legal location and by linking that soils information to interpretations of concern in conservation planning.

MODEL COMPONENTS

- SIDMAP type tabular soils data registered to 1/4 section legal location (Agriculture Canada & Alberta Agriculture).
- Tabular DBMS file of Soil Names File (SNF) information for soils of Warner County (Agriculture Canada, CLBRR, Alberta Unit - see Appendix A)
- Tabular DBMS file of Soil Layer File (SLF) information for soils of Warner County (Agriculture Canada, CLBRR, Alberta Unit - see Appendix A)
- Tabular DBMS lookup table relating soils and topo classes to conservation concerns (SOILCONS).
- PASCAL program to enable interactive, graphical selection, interrogation and display of the data.
- CLIPPER (TM) programs to generate custom reports for selected 1/4 sections or to record new data for 1/4 sections.

MODEL OPERATION

- PASCAL program (GRIDS) reads and displays 1/4 section data to screen using up to 12 colors to represent classes of soil data.
- 1/4 sections of interest selected by moving cursor to area(s) of interest and pressing (RET).
- Pull down menus used to select class of coverage to display.
- Pull down menus used to record additional data relative to 1/4 sections.
- Pull down menus used to invoke various CLIPPER (TM) programs that produce reports detailing soils in 1/4 section(s) of interest and relating soils to conservation issues and management options.

APPLICATIONS

- Presently limited to specific application of assisting in the preparation of county wide and farm scale conservation plans for the County of Warner.

USERS

Bob Forest, Agricultural Fieldman and Keith Heggie, CASCI Technician, County of Warner No. 5.

HARDWARE REQUIREMENTS

- IBM PC/AT (286) and an EGA adapter and EGA screen (color recommended)
- 640 KB RAM with 3-4 MB disk space for program and data

WSIS: WARNER SOIL INFORMATION SYSTEM

TECHNICAL DESIGN & IMPLEMENTATION

R. A. MacMillan, R. Forest, R. W. Howitt
and
W. P. A. Van Deursen

Environmental Research & Engineering Dept.
Alberta Research Council
12/17/91

OUTLINE

1) Technical objectives
2) Technical design/organization of WSIS
3) Implementation strategy for WSIS
4) Evaluation of WSIS technical successes and limitations
5) Recommendations for technical improvements or extensions for WSIS

TECHNICAL OBJECTIVES

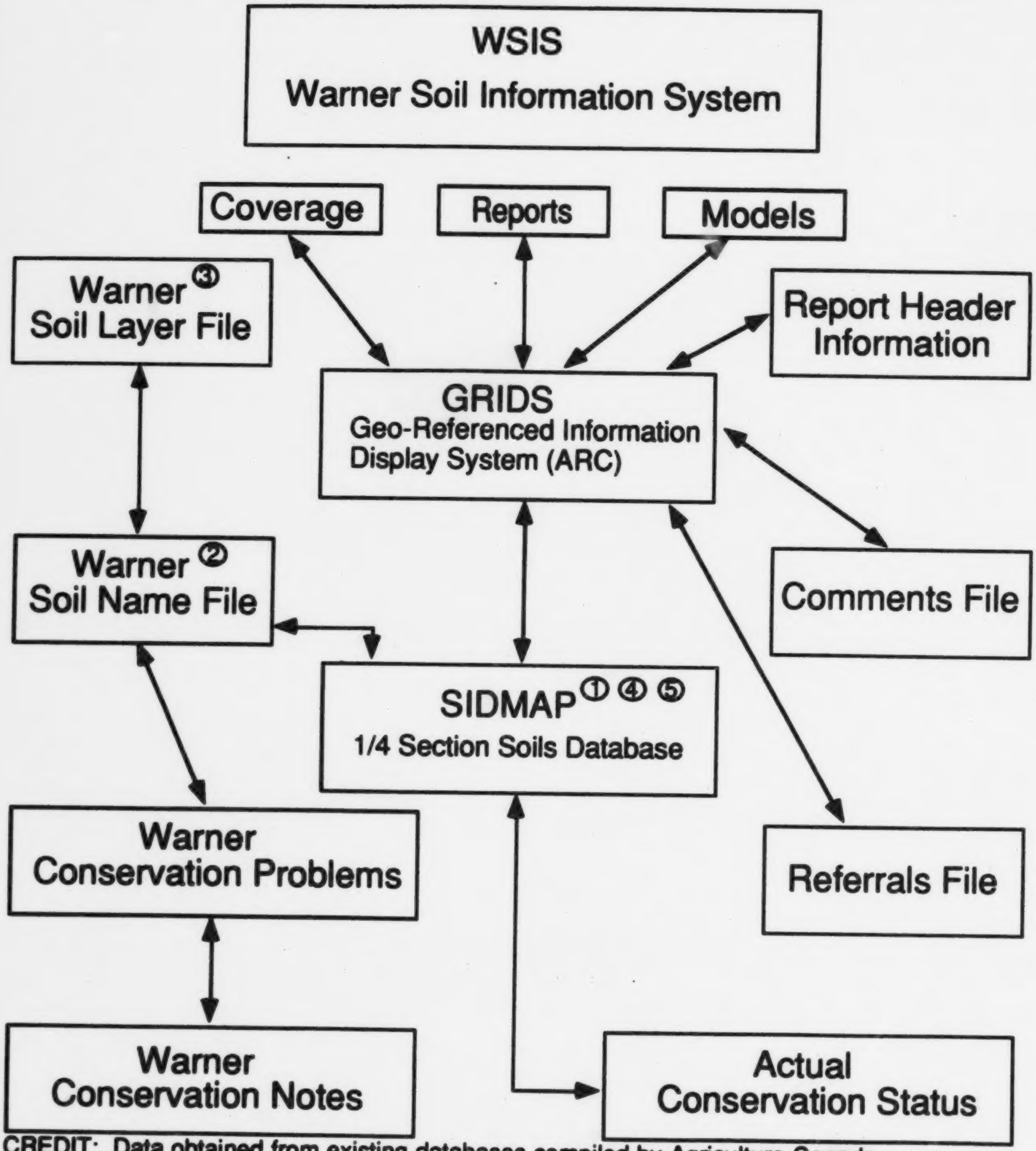
1) Provide user-friendly access to tabular soils data referenced to quarter section management units.

2) Link soils information to potential soil conservation problems.

3) Provide information on the probable sources of predicted conservation problems and list recommended management options and strategies for effective conservation.

4) If possible, provide a graphical display environment to permit illustration of the 1/4 section soil data (for the entire county) on a computer screen.

TECHNICAL DESIGN / ORGANIZATION



WSIS

Warner Soil Information System

Coverage

Reports

Models

Warner ③
Soil Layer File

Report Header
Information

GRIDS
Geo-Referenced Information
Display System (ARC)

Warner ②
Soil Name File

Comments File

SIDMAP ① ④ ⑤
1/4 Section Soils Database

Warner
Conservation Problems

Referrals File

Warner
Conservation Notes

Actual
Conservation Status

CREDIT: Data obtained from existing databases compiled by Agriculture Canada.
See Appendix A for specific data credits.

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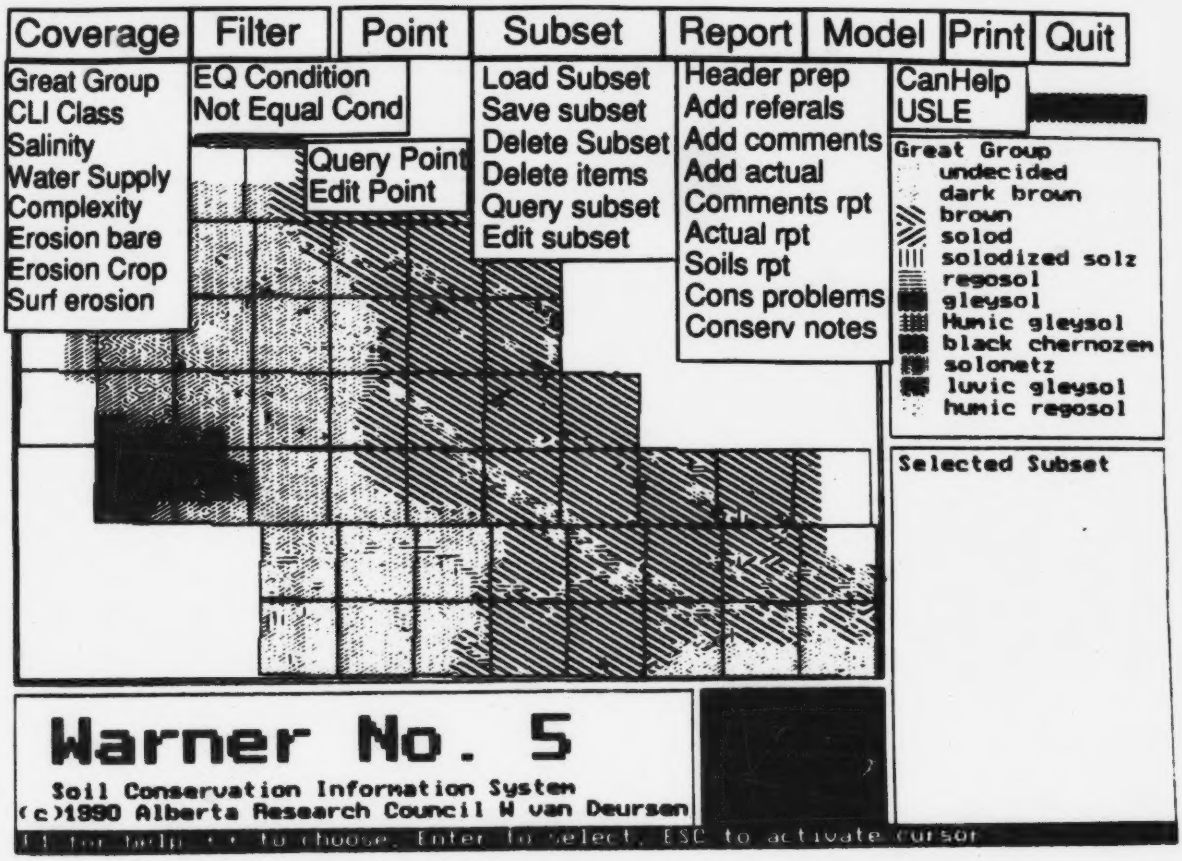
IMPLEMENTATION OF WSIS

WSIS: Menu Structure and Functions:


Coverage
Filter
Point
Subset
Report
Model
Print
Quit
Great Group
CLI Class
Salinity
Water Supply
Complexity
Erosion bare
Erosion Crop
Surf erosion
EQ Condition
Not Equal Cond
Query Point
Edit Point
Load Subset
Save subset
Delete Subset
Delete items
Query subset
Edit subset
Header prep
Add referals
Add comments
Add actual
Comments rpt
Actual rpt
Soils rpt
Cons problems
Conserv notes
CanHelp
USLE
Great Group
undecided
dark brown
brown
solod
solodized solz
regosol
gleysol
Humic gleysol
black chernozem
solonetz
luvic gleysol
humic regosol
Selected Subset

Warner No. 5

Soil Conservation Information System
(c)1990 Alberta Research Council W van Deursen

F1 for help ← → to choose, Enter to select, ESC to activate cursor

TECHNICAL EVALUATION OF WSIS

Technical Successes

1) Provides low end, cost effective, graphical access and display of tabular soils data referenced to ATS 1/4 section legal locations.

2) Builds link between names of soil series located on 1/4 and properties of soils.

3) Builds link between soil properties and topography and potential soil conservation problems/concerns.

4) Provides summary of likely causes of soil conservation problems and recommended management strategies or options for effective conservation.

5) Permits input, storage and retrieval of user recorded observations pertaining to the 1/4 sections.

6) Is very easy to add data or capabilities to. Very open, flexible architecture permits software to be used for other areas or other data.

TECHNICAL EVALUATION OF WSIS

Technical Limitations

1) SIDMAP type of recording of 1st, 2nd and 3rd soil series by 1/4 section is more difficult to use for interpretations than recording of 1st, 2nd and 3rd soil landscape map units.

2) Linking of soil types and soil properties to potential conservation problems is imperfect.

3) Quality of tabular printed output could be improved.

4) Options for high quality plotting of maps not available.

5) Doesn't incorporate modelling functions as yet.

6) Tools not provided to permit users to alter, customize or extend the delivered capabilities of WSIS.

7) EGA screen limits representation of data to the 12 available colors.

RECOMMENDATIONS FOR TECHNICAL IMPROVEMENTS / EXTENSIONS

1) Replace SIDMAP type data structure with soil landscape type map unit structure.

2) Locate or develop better algorithms for identifying degree and extent of potential conservation problems based on combinations of soils, topography and land use.

3) Replace current SOILCONS lookup table with improved lookup table relating soils + topography to potential conservation problems.

4) Rewrite programs that generate tabular reports so that reports are more acceptable for users.

5) Add capability to generate plot file of map that can be sent to high quality output device (laser printer/plotter).

RECOMMENDATIONS FOR TECHNICAL IMPROVEMENTS / EXTENSIONS

6) Write code that allows existing models (USLE, CanHelp) to run inside WSIS using data from WSIS files wherever possible and storing results by 1/4 section to main database.

7) Provide capability for user to alter, customize or extend WSIS on their own.

8) Upgrade WSIS to VGA so it can use more colors and display more classes.

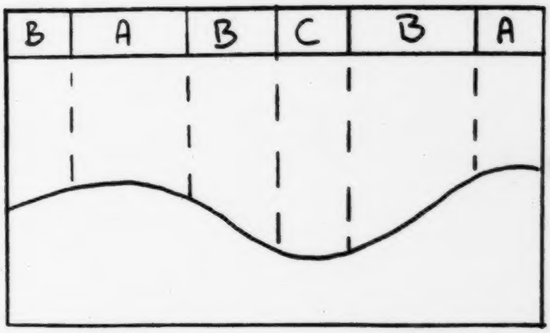
9) Provide non-graphic menu interface for routine queries not requiring illustration of the data.

10) Use WSIS software to package and distribute soils data for other counties and MD's in Alberta.

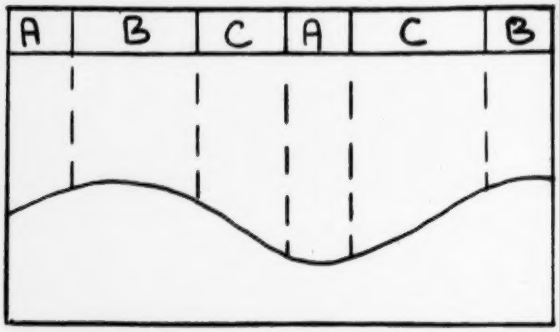
Illustration of the limitations of SIDMAP data structure versus a data structure based on soil landscape map units.

SIDMAP

QTR	DOM	DOM %	SIG1	SIG1 %	SIG2	SIG2 %	TOP1	TOP1 %	TOP2	TOP2 %
NE23	A	60	B	30	C	10	2	60	3	40

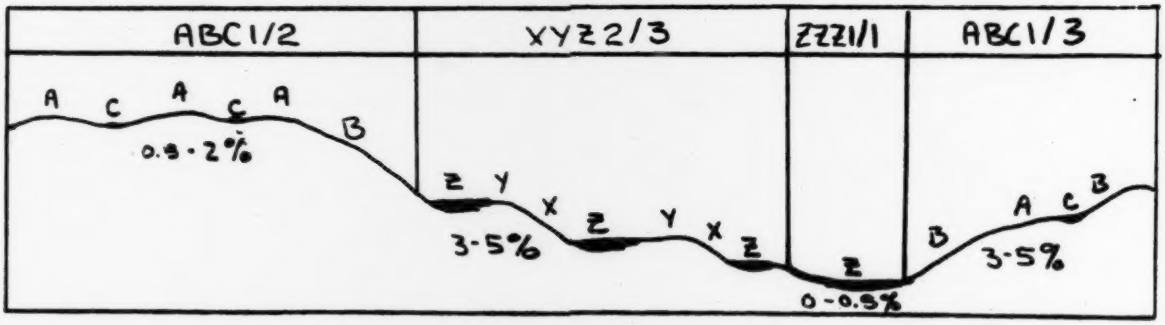


OR



SOIL / LANDSCAPE MAP UNITS

QTR	MU1	MU1 %	MU2	MU2 %	MU3	MU3 %
NE23	ABC1/2	60	XYZ2/3	30	ZZZ1/1	10


ABC1/2
XYZ2/3
ZZZ1/1
ABC1/3
A
C
A
C
A
B
0.5 - 2%
Z
Y
X
Z
Y
X
Z
3-5%
Z
0-0.5%
B
A
C
B
3-5%

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12/9/91

SIDMAP DATA TABLE

SIDMAP data table: original quarter section soils data **Source: Agriculture Canada, Alberta Agriculture joint compilation**

```
Structure for database: D:warner.dbf
Number of data records:     7005
Date of last update    : 10/09/90
Field  Field Name  Type       Width    Dec            Description
    1  MER         Character      1                   Meridian
    2  TWP         Character      3                   Township
    3  RNG         Character      2                   Range
    4  SEC         Character      2                   Section
    5  QSEC        Character      2                   Quarter Section
    6  X1          Numeric       11      3            NTS Easting of SW corner of 1/4 section
    7  Y1          Numeric       11      3            NTS Northing of SW corner of 1/4 section
    8  X3          Numeric       11      3            NTS Easting of NE corner of 1/4 section
    9  Y3          Numeric       11      3            NTS Northing of NE corner of 1/4 section
   10  SSDOM       Character      5                   Dominant Soil Series code
   11  SSDOMD      Character      2                   Decile proportion of dominant soil series
   12  GGCLASS     Numeric        2                   Numeric code for Great Group class of dominant soil series
   13  SACLASS     Numeric        2                   Numeric code for salinity class of dominant soil series
   14  SSSIG1      Character      5                   Soil Series code for next most significant soil series in 1/4
   15  SSSIG1D     Character      2                   Decile proportion of second significant soil series in 1/4
   16  SSSIG2      Character      5                   Soil Series code for third significant soil series in 1/4
   17  SSSIG2D     Character      2                   Decile proportion of third significant soil series in 1/4
   18  TDOM        Character      3                   Topographic class occupying the dominant proportion of the 1/4
   19  TDOMD       Character      2                   Decile proportion of area of 1/4 occupied by dominant topography
   20  TSIG        Character      3                   Topographic class occupying lesser but significant proportion of 1/4
   21  TSIGD       Character      2                   Decile proportion of area of 1/4 occupied by significant topography
   22  CLIMATE     Character      3                   Agroclimatic zone in which 1/4 is located
   23  CLIDOM      Character      3                   Dominant Canada Land Inventory (CLI) rating for the 1/4 section
   24  CLIDOMD     Character      2                   Decile proportion of area of 1/4 covered by dominant CLI class soils
   25  CLICLASS    Numeric        2                   Integer code corresponding to dominant CLI class
   26  CLISIG1     Character      3                   Second most extensive (significant) CLI rating for soils in this 1/4
   27  CLISIG1D    Character      2                   Decile proportion of area of 1/4 covered by significant CLI class soils
   28  CLISIG2     Character      3                   Third most extensive (significant) CLI rating for soils in this 1/4
   29  CLISIG2D    Character      2                   Decile proportion of area of 1/4 covered by third most extensive CLI class
   30  WSC1        Character      3                   Water supply capacity of the dominant soils in the 1/4 section
   31  WSC1CODE    Numeric        1                   Integer code corresponding to the dominant water supply capacity
   32  ARIDITY     Character      4                   Aridity index calculated for the 1/4 as a whole
   33  A           Character      5                   Aridity Index associated with dominant soil series in this 1/4
   34  ACLASS      Numeric        1                   Integer code used to classify dominant aridity index for display
   35  A2          Character      5                   Aridity Index associated with the sub-dominant soil series in this 1/4
   36  A2CLASS     Numeric        1                   Integer code used to display sub-dominant aridity index
   37  AW          Numeric        1                   Actual, observed class of water erosion on the 1/4 as a whole
   38  AG          Numeric        1                   Actual, observed class of gully erosion on the 1/4 as a whole
   39  AD          Numeric        1                   Actual, observed class of wind erosion on the 1/4 as a whole
   40  AS          Numeric        1                   Actual, observed class of salinity on the 1/4 as a whole
   41  ACC         Numeric        1                   Actual, estimated rangeland carrying capacity of the 1/4
   42  PCC         Numeric        1                   Potential, estimated rangeland carrying capacity of the 1/4
   43  PD          Numeric        1                   Potential, estimated wind erosion class for the 1/4
   44  PS          Numeric        1                   Potential, estimated salinity class for the 1/4
   45  CROPCOVER   Numeric        2                   Last observed and recorded crop cover class for the 1/4
   46  SLPLEN      Numeric        3                   Estimated average slope length for slopes in the 1/4
```

Example report for WARNER.dbf SIDMAP data

```
-------------------------------------------------------------------------------------------------------------------------------------------------
Mer Twp Rg Sec 1/4   X1  ie SW     Y1 ie SW     X3 ie NE     Y3 ie NE Dom'nt Dom  GG Sal Sig1   Sig Dom  Dom  Sig  Sig  Clim Dom  Dom   Dom Sig
               Sec     easting    northing       easting    northing Soil   dec Cls Cls Soil   dec Topo Topo Topo Topo Zone CLI  CLI   CLI CLI
                   of 1/4 sec  of 1/4 sec   of 1/4 sec  of 1/4 sec Series pct          Series pct CLS  dec  CLS  dec       Class dec   Cls Cls
-------------------------------------------------------------------------------------------------------------------------------------------------
4   001 11 01  NE  474310.130 5428081.779  475110.629 5428073.773 CRD    06    2   1 VEB    03  4    08   3    02   2A   4FM   08      4 3M
4   001 11 01  NW  473506.025 5428085.559  474306.407 5428077.437 CRD    04    2   1 VEB    02  4 D  03   5 D  03   2A   4T    03      4 5TF
4   001 11 01  SE  474306.407 5428077.437  475107.023 5427269.431 CRD    05    2   1 WHY    02  3    06   4    04   2A   3M    05      3 4FM
4   001 11 01  SW  473502.186 5428081.217  474302.685 5427273.095 ZRB    04    1   0 CRD    02  6    04   4 D  02   NA   6T    04      6 4D
4   001 11 02  NE  472681.818 5428089.555  473482.080 5428081.313 CRD    07    2   1 VEB    02  4 D  10        00   2A   4T    10      4
4   001 11 02  NW  471877.713 5428093.571  472677.859 5428085.213 CRD    07    2   1 VEB    01  4 D  05   3    04   2A   4T    05      4 3M
4   001 11 02  SE  472677.859 5428085.213  473478.238 5427276.972 CRD    07    2   1 VEB    02  4 D  10        00   2A   4T    08      4 4D
4   001 11 02  SW  471873.638 5428089.229  472673.901 5427280.872 CRD    07    2   1 VEB    02  4 D  09   3    01   2A   4T    09      4 3M
4   001 11 03  NE  471053.506 5428097.809  471853.533 5428089.331 CRD    08    2   1 VEB    01  3    10        00   2A   3M    10      3
4   001 11 03  NW  470249.402 5428902.061  471049.312 5428093.467 MKR    05    6   1 CRD    03  3    10        00   NA   6FM   05      6 3M
-------------------------------------------------------------------------------------------------------------------------------------------------
```

The SIDMAP table identifies the legal location of each parcel of land for which information about the soil composition and topography is presented. Four additional fields (X1, Y1, X3, Y3) are added to the "normal" SIDMAP data structure to define the UTM coordinates for the SW and NE corners of the quarter section. These coordinates permit the location of each quarter section to be calculated and displayed to a computer screen. Most of the remainder of the file is concerned with listing the three letter codes that identify the three most extensive soil series mapped in the quarter section and the estimated proportion of each quarter section occupied by each of (up to) three series. Information is also listed on the relative extent of the two most extensive classes of topography mapped in the quarter (fields 18-21). This is the basic data on which all other information rests. A number of the subsequent fields (22-36) contain data based on interpretation of the assigned or observed characteristics of the dominant soil series in the quarter. The climate field identifies the agro-climatic zone in which the dominant soil series is recognized to occur. The CLI fields (23-29) give the Canada Land Inventory (CLI) capability for agriculture rating for the three most extensive CLI classes in the quarter section and indicate the relative extent of these classes. A numeric field (25) was added to permit display of the dominant CLI class to the computer screen. Fields 30-36 record values for the water supply capacity (WSC) and aridity index as estimated for the dominant soil series of the quarter section using a method documented by Tajek et al. (1989). Fields 37-41 were added at the request of the County of Warner users in order to permit recording of the actual, observed status of water erosion (37), gully erosion (38), wind erosion (39), salinity (40) and rangeland carrying capacity (41).

SOIL NAMES FILE

```
Warner Soil Names File (WSNF) data table                        Source: Agriculture Canada - SIDMAP soil names file

Structure for database: D:wsnf.dbf
Number of data records:       96
Date of last update    : 10/11/90

Field  Field Name  Type        Width    Dec         Description
    1  SER         Character      15                Soil Series name
    2  CD2         Character       4                Soil Series 3 letter code (4 letters if variant)
    3  SORTCAT     Character       7                Code used to facilitate sorting soil series
    4  SOILDESC    Memo           10                Description and comments for correlation purposes
    5  PHAS        Character       4                Phase of soil series (if appropriate)
    6  ORD         Character       4                ORDER in which soil series is placed in Canadian classification
    7  GG          Character       3                GREAT GROUP in which soil series is placed
    8  SG          Character       4                SUBGROUP classification of soil series
    9  CACL        Character       3                Calcareousness class of soil series
   10  SACL        Character       3                Salinity class of soil series
   11  REAC        Character       3                Reaction class of soil series
   12  PSD1        Character       3                Particle size class (texture) of topmost parent material
   13  PSD2        Character       3                Particle size class (texture) of underlying parent material
   14  PMT1        Character       4                Mode of origin (type) of topmost parent material
   15  PMT2        Character       4                Mode of origin (type) of underlying parent material
   16  ACCM        Character       3                Agro-climatic area in which soil series occurs
   17  CLIA        Character       3                Canada Land Inventory (CLI) capability for agriculture classif
   18  ACLS        Character       1                Integer value of CLI soil capability class
   19  ASC1        Character       2                Alphabetic symbol identifying the dominant CLI limitation
   20  ASC2        Character       2                Alphabetic symbol identifying the sub-dominant CLI limitation
   21  DRAINAGE    Character       2                Drainage class of of the soil series
   22  TOP_TEXT    Character       6                USDA texture of the surface horizon (topsoil)
   23  TOP_PH      Numeric         4      1         Estimated pH of the surface horizon (topsoil)
   24  K_FACTOR    Numeric         5      3         estimated USLE erosion equation K-factor for series topsoil
** Total **                      103
```

Example report for Warner Soil Names File (WSNF) data

Soil Series Name	Soil Series Code	Soil phase	Soil Order	Soil Great Group	Soil Sub-Group	Calc class	Salinity Class	Reaction Class	Particle Size Dist Class(es)	Parent Material Type(s)	Agro Clim Area	CLI full symb	CLI Class No.	CLI Lim1 type	CLI Lim2 type	Drainage Class	Top Soil Texture	Top Soil pH	USLE Topsoil K-Factor
CRADDUCK	CRD	NORM	CHER	DB	O.DB	NC	NS	ALK	FNL- X	TL- X	2A	3M	3	M	NL	W	L	6.5	0.034
MISC.ROUGH	ZRB	NORM	ND	ND	ND	ND	ND	ND	ND- ND	ND- ND	ND	7T	7	T	NL	ND	ND	-9.0	0.035
MILK.RIVER	MKR	NORM	REGO	R	CU.R	NC	NS	ALK	COL- X	FL- X	3A	6MF	6	M	F	R	LS	7.4	0.020
SPROLE	SOL	NORM	CHER	DB	O.DB	NC	NS	ALK	FNC- X	TL- X	2A	3M	3	M	NL	MW	CL	7.1	0.028
MASINASIN	MSN	NORM	CHER	B	OB	NC	NS	ALK	FNL- X	TL- X	3A	4M	4	M	NL	W	L	7.7	0.040
HALLIDAY	HDY	NORM	SOLZ	SO	BSO	NC	NS	N	FNL- X	TL- X	3A	4D	4	D	NL	W	SiL	6.2	0.042
WESTON	WTN	NORM	REGO	R	O.R	NC	NS	ALK	FNC- X	LC- X	2A	3F	3	F	NL	MW	C	5.9	0.021
NEW.DAYTON	NED	NORM	CHER	DB	O.DB	NC	NS	ALK	SSK- X	GLFL- X	2A	4M	4	M	NL	R	L	7.1	0.020
HEMARUKA	HUK	NORM	SOLZ	SS	BSS	NC	NS	ALK	FNL- X	TL- X	3A	4D	4	D	NL	W	L	4.5	0.045
GEM	GEM	NORM	SOLZ	SO	BSO	NC	NS	ALK	FNL- X	GLLC- TL	3A	4D	4	D	NL	W	SiL	6.2	0.046

The key field in this data table is field 2 (CD2). This is the three letter (or 4 if variant) soil series code that is used to link the soil series identified in the SIDMAP data base with their respective attributes and properties as recorded in this data table (the Warner Soil Names File) and in the Warner Soil Layer File which contains data on the estimated physical and chemical properties of the various layers, or horizons, for each soil series. The majority of fields in this data table relate the soil series code to classifications or interpretations applicable to that series. Any series listed in the main SIDMAP data table can be located in this Soil Names File by reference to its 3 (or 4) letter code. Once located, the various applicable classifications or interpretations can be identified and reported.

Credit: Assistance in obtaining, subsetting and using the information extracted from the CanSIS soil names file was provided by J. Tajek, Agriculture Canada, Centre for Land and Biological Resource Research (Alberta Unit).

SOIL LAYER FILE

Warner soil layer file (WSLF) data table **Source: Agriculture Canada (CLBRR), CanSIS soil layer file for Alberta**

```
Structure for database: D:warslf.dbf
Number of data records:     480
Date of last update    : 10/01/90

Field  Field Name  Type       Width    Dec     Description
    1  PROVINCE    Character      2            Province in which the soil series is described
    2  SOIL_CODE   Character      3            3 letter code used to identify soil series
    3  MODIFIER    Character      3            up to 3 letter modifier used to identify soil variants
    4  LU          Character      1            Land use most associated with soil series
    5  LAYER_NO    Character      1            Sequential layer number
    6  HZN_LIT     Character      1            Roman numerial identifying successive parent materials
    7  HZN_MAS     Character      3            Master horizon identifier (ie A,B,C,R or LFH)
    8  HZN_SUF     Character      5            Horizon suffix identifying type of horizon (ie. b,t,n,)
    9  HZN_MOD     Character      1            Horizon modifier (ie 1, 2, 3)
   10  UDEPTH      Numeric        3            Depth of top of horizon (cm)
   11  LDEPTH      Numeric        3            Depth of bottom of horizon (cm)
   12  TEXTURE     Character      6            USDA texture class of the horizon
   13  COFRAG      Numeric        3            Percent coarse fragment content of the horizon
   14  COF_E       Character      3            Indicates if coarse fragment content is estimated (E)
   15  DOMSAND     Character      2            Size of sand particles dominating the sand fraction of soil
   16  VFSAND      Numeric        3            Percent very fine sand (VFS) in horizon (needed for USLE)
   17  VFS_E       Character      3            Indicates if VFS fraction is estimeted (E)
   18  TSAND       Numeric        3            Percent total sand in horizon
   19  TSA_E       Character      3            Indicates if total sand is estimated (E)
   20  TSILT       Numeric        3            Percent total silt in horizon
   21  TSI_E       Character      3            Indicates if total silt is estimated (E)
   22  TCLAY       Numeric        3            Percent total clay in horizon
   23  TCL_E       Character      3            Indicates is total clay is estimated (E)
   24  ORGCARB     Numeric        5      1     Percent organic carbon of the horizon (upper horizons only)
   25  ORG_E       Character      3            Indicates if organic carbon is estimeted (E)
   26  PHCA        Numeric        4      1     pH in CaCl2
   27  PHC_E       Character      3            Indicates if PHCA is estimated (E)
   28  PH2         Numeric        4      1     pH in H2O
   29  PH2_E       Character      3            Indicates if PH2 is estimated (E)
   30  BASES       Numeric        2            Total bases on exchange complex
   31  BAS_E       Character      3            Indicates if total bases were estimated (E)
   32  CEC         Numeric        3            Cation Exchange Capacity (CEC) of the soil horizon
   33  CEC_E       Character      3            Indicates if CEC is estimated (E)
   34  KSAT        Numeric        6      3     Saturated hydraulic conductivity (cm/hr)
   35  KSA_E       Character      3            Indicates if KSat is estimated (E)
   36  KP0         Numeric        3            Moisture content (in %) at saturation (0 pressure head)
   37  KP0_E       Character      3            Indicates if KP0 is estimated (E)
   38  KP10        Numeric        3            Moisture content (in %) at 1/10 bars
   39  KP10_E      Character      3            Indicates if KP10 is estimated (E)
   40  KP33        Numeric        3            Moisture content (in %) at 1/3 bars (field capacity)
   41  KP33_E      Character      3            Indicates if KP33 is estimated (E)
   42  KP1500      Numeric        3            Moisture content (in %) at 15 bars (wilting point)
   43  KP1500_E    Character      3            Indicates if KP1500 is estimeted (E)
   44  BD          Numeric        5      2     Bulk density of the undisturbed soil
   45  BD_E        Character      3            Indicates if bulk density is estimated (E)
   46  EC          Numeric        3            Electrical conductivity (mS m-2) of a saturated paste
   47  EC_E        Character      3            Indicates if the EC is estimated (E)
   48  CACO3       Numeric        2            Calcium carbonate percent of the soil material (%)
   49  CAC_E       Character      3            Indicates if CACO3 is estimated (E)
   50  VONPOST     Numeric        2            Von Post measure of decomposition of organic materials
   51  VON_E       Character      3            Indicates if von Post is estimated (E)
   52  WOOD        Numeric        2            Percent wood composition of layer
   53  WOO_E       Character      3            Indicates if wood percent is estimeted (E)
   54  DATE        Date           8            Date soils eries was entered or updated
   55  SORTCAT     Character      7            Field used to help sort data base
   56  SORTCAT2    Character      7            Second field used to sort data base
   57  ARA         Character      2            Agricultural resource area in which soil series is found
   58  CODE        Character      3            Code used to help manage data base
   59  SORTCAT3    Character      5            Third field used to help sort data base
** Total **                     192
```

Example report for Warner Soil Layer File (WSLF)

Soil Code	Soil Code Mod	Layer Num.	Horizon Type	Horizon Depth	USDA Texture Class	Crs Frag pct	Dom Sand Frac	Very fine sand pct	Total Sand pct	Total Silt pct	Total Clay pct	Org Carb pct	pH in CaCl2	pH in H2O	Total Bases	CEC est	KSat est	KP0 est	KP33 est	KP 1500 est	BD est	EC est	CACO3 est
ANO		1	Ah1	0- 3		0	F	14	54	32	14	2.1	7.1	7.5	99	16	10.000	51	17	10	1.30	0	0
ANO		2	Ah2	3- 16		0	F	15	59	28	13	1.0	7.0	7.4	99	11	10.000	51	14	8	1.30	0	0
ANO		3	Bm1	16- 36		0	F	17	77	13	10	0.4	7.4	7.7	99	8	30.000	47	13	6	1.40	0	0
ANO		4	Bm2	36- 55		0	F	17	73	16	11	0.2	7.4	7.7	99	7	30.000	47	15	7	1.40	0	0
ANO		5	2Ck	55-100		5	F	9	21	51	28	0.0	7.7	7.9	99	16	3.000	43	23	12	1.50	0	11

The Warner soil layer file (WSLF) contains data on the physical and chemical properties of the main layers, or horizons, for each soil series identified for the County of Warner in the main SIDMAP data table. For some soil series, the reported data were obtained from one or more sampled soil profiles. For many of the soil series, the reported data are estimated based on laboratory analyses data for the same layers of very similar soils. The estimated values are the best available at the current time and reflect realistic estimates of the likely central or mean value for the property in question for the soil series of interest. This does not mean that all soils identified as belonging to the named soil series will display the recorded values for all properties. Considerable variation in values is to be expected and on-site sampling is required if precise and accurate determinations of soil properties are needed.

Credit: Assistance in obtaining, subsetting and using the information extracted from the CanSIS soil layer file was provided by J. Tajek, Agriculture Canada, Centre for Land and Biological Resource Research (Alberta Unit).

SOILCONS DATA TABLE

Data table relating soil properties and topographic class to potential conservation problems (SOILCONS)

```
Structure for database: D:soilcons.dbf
Number of data records:     327
Date of last update   : 10/10/90

Field  Field Name  Type       Width    Dec      Description
    1  SOIL        Character      5             3 letter soil code
    2  TOPO        Character      3             dominant topographic class in 1/4
    3  WATER       Numeric        1             presence/absence of potential water ersosion problem
    4  WIND        Numeric        1             presence/absence of potential wind erosion problem
    5  SALINE      Numeric        1             presence/absence of potential salinity problem
    6  RANGE       Numeric        1             presence/absence of potential rangeland grazing problem
    7  K_FACTOR    Numeric        5      3      USLE K-Factor for the topsoil
    8  SAL_CLASS   Character      2             Salinity class for the soil
    9  GRAZ_CLASS  Character      1             Grazing rangeland capability class for the soil
** Total **                      21
```

Example report for SOILCONS data table

```
 SOIL  TOPO WATER WIND SALINE RANGE K_FACTOR SAL_CLASS GRAZ_CLASS
------------------------------------------------------------------
 ANO   3        1    2      3     4    1.234 NS            2
 ANO   4        1    2      3     4    1.234 NS            2
 ANO   6        1    2      3     4    1.234 NS            2
 BUT   3        1    2      3     4    1.234 NS            2
 BUT   4        1    2      3     4    1.234 NS            2
 BUT   6        1    2      3     4    1.234 NS            2
 BVL   3        1    2      3     4    1.234 NS            2
 BVL   4        1    2      3     4    1.234 NS            2
 BVL   6        1    2      3     4    1.234 NS            2
 BVLG  3        1    2      3     4    1.234 NS            2
------------------------------------------------------------------
```

This table is used to relate the soil series code (or codes) recorded for each quarter section to the presence or absence of potential conservation problems. The specific conservation problems identified are water erosion (3), wind erosion (4), salinity (5) and rangeland carrying capacity (6). Originally, the intent was to identify the degree or severity of potential conservation problem associated with each combination of soil series and topography. In the end, there was neither sufficient time nor sufficiently detailed data to permit this degree of precision to be atttained. The table identified only the presence or absence of a potential problem with respect to each of the potential types of problem. This soil conservation problem lookup table could be improved with additional time and effort and it is recommended that efforts should be made to upgrade it.

Credit: Two of the main components of soil conservation data included in the Warner Soil Information System (SIDMAP data table) were obtained from previously published work carried out by Agriculture Canada (CLBRR). This additional data consists of estimates of potential soil erosion by quarter section (SOILEROS data base, Tajek et. al., 1985) and estimates of soil moisture limits and aridity index (Tajek et. al., 1989). Assistance in obtaining, interpreting and using this data was provided by J. Tajek, Agriculture Canada, Centre for Land and Biological Resource Research, Alberta Unit.

Tajek J., W. W. Pettapiece and K.E. Toogood. 1985. Water erosion potential of soils in Alberta. Agric. Can. Tech. Bull No. 1985-29. Ottawa. (SOILEROS data base of USLE water erosion estimates)

Tajek, J., W.W. Pettapiece and K.E. Toogood. 1989. Water supplying capacity of Alberta soils. LRRC Publ. 89-117. Ottawa, AIP publ. M-89-2. Edmonton. (SOILARID data base of soil moisture limits and aridity index)

COMMENTS TABLE

Data table for recording comments pertaining to 1/4 section (COMMENTS)

```
Structure for database: D:comments.dbf
Number of data records:       6
Date of last update    : 12/02/91
Field  Field Name  Type        Width    Dec        Description
    1  LOCKEY      Numeric         5               Unique number - recno() in main data base for this 1/4
    2  COMMENTS    Character      40               Comments recorded for the quarter by the conservationist
    3  DATE        Date            8               Date comments were recorded
** Total **                       54
```

Example report of comments recorded for selected 1/4 sections

```
 LOCKEY COMMENTS                                   DATE
-------------------------------------------------------------
   6277 good piece of land                         09/05/90
   6274 highly eroded                              09/05/90
   4344 first visit                                09/05/90
   6273 Blowing noticed on Sept 6/90   \           09/06/90
   6277 5 acres of salinity in SW of quarter       09/07/90
   6274 Trying to minimize tillage                 09/07/90
-------------------------------------------------------------
```

The COMMENTS data table was added to the WSIS system at the request of the client users (County of Warner staff). The intention of this table was to permit recording of comments pertaining to any given quarter section of land investigated in conjunction with soil conseervation planning activities. Field 1 (LOCKEY) acts as a locational key to relate the recorded comment to a particular quarter section. The number in the field LOCKEY corresponds to the record number assigned to that particular quarter in the main SIDMAP data table. Each quarter section has a unique record number so it is possible to store the coments information and relate it to a specific quarter section without having to repeat the full legal description of the quarter section each time a comment is recorded.

REFERRALS TABLE

Data table for recording referrals pertaining to 1/4 section (REFERRALS)

```
Structure for database: D:referral.dbf
Number of data records:       5
Date of last update    : 12/02/91
Field  Field Name  Type        Width    Dec        Description
    1  FARMERNAME  Character      20               Farmer/operator name
    2  LOCKEY      Numeric         5               Unique key for location of 1/4
    3  REFERRED    Date            8               Date problem referred to identified agency
    4  INITIALS    Character       4               Initials of conservationist making referral
    5  AGENCY      Character      10               Name of agency referral made to
    6  REASON      Character      20               Reason for referral
    7  COMMENTS    Character      70               General comments
** Total **                      138
```

Example report for referrals data

```
-----------------------------------------------------------------------------------------------------
Unique Name of farm              Referred Ref  Agency    Reason               Comments
   Loc operator                  to some  by   referred  for
   Key                           agency        to        referral
-----------------------------------------------------------------------------------------------------
  6274 John B. Smith             09/06/90 0000 PFRA      Salinity Survey      Farmer concerned about growing
                                                                              salinity. Referred to PFRA.
  6274 Jones                     09/06/90 WPA  ARC       Salinity survey      Very saline soils in his farm.
  6270 Jones                     09/07/90 RAM  PFRA      Water erosion        Severe gully erosion in S part
                                                                              of quarter.
  5382 James T. Jones            09/28/90 RB   PFRA      Salinity Survey      Complains about increasing
                                                                              salinity in SE of Quarter
  5429 R. Mac Millan             10/03/90 RM   PFRA      Salinity Survey      Some spreading salinity in SE
                                                                              of quarter
-----------------------------------------------------------------------------------------------------
```

The REFERRALS table is similar to the COMMENTS table in function and organization. It was included in WSIS at the request of the users in order to permit recording of any referrals regarding the quarter section made to any external agency during the course of soil conservation investigations by the county. The record number of the quarter section in the main SIDMAP data table is again used as the unique location key (LOCKEY) and fields are defined to record the person making the referral, the date of referral, the agency to which the referral was made and comments concerning the referral, as well as the name of the farmer/operator of the quarter section.

ACTUAL STATUS REPORT

Example report for actual status of 1/4 sections as recorded in Warner.dbf

Mer	Twp	Rg	Sec	1/4 Sec	X1 ie SW easting of 1/4 sec	Y1 ie SW northing of 1/4 sec	X3 ie NE easting of 1/4 sec	Y3 ie NE northing of 1/4 sec	Dom'nt Soil Series	Dom dec pct	Actual Water Erosion	Actual Wind Erosion	Actual Salinity	Actual Carrying Capacity	Potential Carrying Capacity	Future Wind Erosion	Status Salinity	Crop Cover Class
4	001	11	01	NE	474310.130	5428881.779	475110.629	5428073.773	CRD	06	0	0	0	0	0	0	0	0
4	001	11	01	NW	473506.025	5428885.559	474306.407	5428077.437	CRD	04	0	0	0	0	0	0	0	0
4	001	11	01	SE	474306.407	5428077.437	475107.023	5427269.431	CRD	05	0	0	0	0	0	0	0	0
4	001	11	01	SW	473502.186	5428081.217	474302.685	5427273.095	ZRB	04	0	0	0	0	0	0	0	0
4	001	11	02	NE	472681.818	5428889.555	473482.080	5428081.313	CRD	07	0	0	0	0	0	0	0	0
4	001	11	02	NW	471877.713	5428893.571	472677.859	5428085.213	CRD	07	0	0	0	0	0	0	0	0
4	001	11	02	SE	472677.859	5428085.213	473478.238	5427276.972	CRD	07	0	0	0	0	0	0	0	0
4	001	11	02	SW	471873.638	5428089.229	472673.901	5427280.872	CRD	07	0	0	0	0	0	0	0	0
4	001	11	03	NE	471053.506	5428897.809	471853.533	5428089.331	CRD	08	0	0	0	0	0	0	0	0
4	001	11	03	NW	470249.402	5428902.061	471049.312	5428093.467	MKR	05	0	0	0	0	0	0	0	0

Provision was made to permit recording of the actual, observed status of of the quarter section with respect to the main soil conservation problems. Fields were inserted into the main SIDMAP data table to permit recording of the observed class of wind erosion, water erosion, salinity and rangeland carrying capacity as well as the current crop cover. The numerical classes recorded were to be based on the various manuals for recording farm scale soil conservation problems published by ALberta Agriculture. The intent was to provide some means of comparing the observed level of conservation problem with that predicted according to the soil types and topographic classes recorded for the quarter section.

CUSTOMIZING/CHANGING WSIS

Data table for inserting and defining additional map coverages in WSIS

```
Structure for database: D:coverage.dbf
Number of data records:       8
Date of last update   : 09/28/90

Field  Field Name  Type       Width    Dec       Description
    1  MAPNAME     Character     13              Name to be given to coverage or map
    2  MAPFIELD    Character     10              Field in the main data base (Warner.dbf) that contains the info to display
    3  HELP        Character     40              Help message to display to the screen for this map coverage
    4  NROFFIELDS  Numeric        2              Number of catagories or classes of data to display for this coverage
    5  FIELD1      Character     15              Legend entry for class 1 for this map
    6  FIELD2      Character     15              Legend entry for class 2 for this map
    7  FIELD3      Character     15              Legend entry for class 3 for this map
    8  FIELD4      Character     15              Legend entry for class 4 for this map
    9  FIELD5      Character     15              Legend entry for class 5 for this map
   10  FIELD6      Character     15              Legend entry for class 6 for this map
   11  FIELD7      Character     15              Legend entry for class 7 for this map
   12  FIELD8      Character     15              Legend entry for class 8 for this map
   13  FIELD9      Character     15              Legend entry for class 9 for this map
   14  FIELD10     Character     15              Legend entry for class 10 for this map
   15  FIELD11     Character     15              Legend entry for class 11 for this map
   16  FIELD12     Character     15              Legend entry for class 12 for this map
** Total **                     246
```

Example report of the contents of the current coverage table

```
---------------------------------------------------------------------------------------------------------------------------------------------
Coverage   Name of   Help message          NO. Class1     Class2   Class3   Class4   Class5    Class6     Class7  Class8    Class9    Class10
Name       field in  for screen            CLS
           main data display
           base table
---------------------------------------------------------------------------------------------------------------------------------------------

Great      GGCLASS   display great group   12 undecided  dark     brown    solod    solodized reqosol    gleysol Humic     black     solonetz
Group                  classification                    brown                      soiz                         gleysol   chernozem
CLI Class  CLICLASS  display Canada Land    7 no         moderate moderate severe   unsuited  unimproved unsuited
                       Inventory classes      limitation limit    severe   limitati cultiv    past       for ag
Salinity   SACLASS   display salinity       4 non saline weakly   moderate strongly
                       classification                    saline   saline   saline
Water      WSC1CODE  display water supply   5 < 60 mm     65 -    125 -    180 -    > 250 mm
supply                 classification                    120 mm   175 mm   220 mm
Complexity SSSIGID   display soil           5 10 % other 20 %     30 %     40 %     50 %
                       complexity (% other    soil       other    other    other    other
                       soils)                            soil     soil     soil     soil
Erosion    ACLASS    display water          6 negligible slight   moderate severe   very      extreme
bare                   erosion of bare soil                                         severe
Erosion    A2CLASS   display water          6 negligible slight   moderate severe   very      extreme
crop                   erosion under cereal                                         severe
Surf       AW        Display                5 Not        W1 -     W2 -     W3 -     W4 -
Erosion                actual/observed        Recorded   Slight   Moderate Severe   Extreme
                       water erosion
---------------------------------------------------------------------------------------------------------------------------------------------
```

Data table used to identify, invoke or add tabular reports within WSIS

```
Structure for database: D:reports.dbf
Number of data records:       9
Date of last update   : 12/02/91

Field  Field Name  Type       Width    Dec       Description
    1  MENUENTRY   Character     13              Text to appear as menu entry in WSIS dialogue box
    2  MODE        Character      4              Identifies for program whether to operate in TEXT or GRAPHICS mode
    3  PRGNAME     Character     80              Name and drive location of program used to generate report from data
    4  ORDER       Numeric        2              Field added to permit order of legend entries to be sorted automatically
    5  CMDLINE     Character     80              Complete command line syntax required to invoke the selected report program
    6  RPTFILE     Character     80              Name and drive location of the file to which the report should be sent
    7  HELP        Character     40              Help message to appear on screen if requested
** Total **                     300
```

Example report listing the contents of REPORT.dbf at the present time

```
-------------------------------------------------------------------------------------------------------------------------------------------------
Text to        Text  Name and Drive              Command line syntax          Name and drive location      Help message to
appear in      or    location of                 used to invoke the           of the appropriate           display to screen
Menu Entry     Graph program that                nominated program            report file
               Mode  effects command
-------------------------------------------------------------------------------------------------------------------------------------------------
Header Prep    TEXT  d:\wsis\prephead.exe        d:\wsis\wsis2\warner         d:\wsis\wsis2\Header.txt   Enter & print data for farm visit header
                                                  d:\wsis\wsis2\Header.txt
Add Referrals  TEXT  d:\wsis\addrefs.exe          d:\wsis\wsis2\warner                                      Add referrals to referral-list
Add Comments   TEXT  d:\wsis\addcomms.exe        d:\wsis\wsis2\warner                                    Add comments linked to quarter section
Add Actual     TEXT  d:\wsis\adactual.exe         d:\wsis\wsis2\warner                                     Record actual conditions for quarters
Comments Rept        d:\wsis\prcomms.exe         d:\wsis\wsis2\warner           d:\wsis\wsis2\comments.txt Report comments recorded for quarters
                                                  d:\wsis\wsis2\comments.txt
Actual Report        d:\wsis\Actual.exe         d:\wsis\wsis2\Warner.dbf     d:\wsis\wsis2\actrep.txt   Displays and prints actual status report
                                                  d:\wsis\wsis2\actrep.txt
Soils Report         d:\wsis\Soilrep.exe         d:\wsis\wsis2\Warner          d:\wsis\wsis2\R.txt        Displays and prints tabular soils report
                                                  d:\wsis\wsis2\Wenf
                                                  d:\wsis\wsis2\WarSLF
                                                  d:\wsis\wsis2\R.txt
Cons Problems        d:\wsis\Conrep.exe          d:\wsis\wsis2\WARNER          d:\wsis\wsis2\Conrep.txt   Identify possible conservation problems
                                                  d:\wsis\wsis2\soilcons
                                                  d:\wsis\wsis2\conrep.txt
Conserv Notes        d:\wsis\Consnotes.exe       d:\wsis\wsis2\Consnote.txt    d:\wsis\wsis2\Consnote.txt Displays and prints conservation notes
-------------------------------------------------------------------------------------------------------------------------------------------------
```

CUSTOMIZING/CHANGING WSIS

Data table for identifying and invoking models from within WSIS (MODELS)

```
Structure for database: D:models.dbf
Number of data records:       2
Date of last update   : 09/07/90
Field  Field Name  Type       Width    Dec
    1  MENUENTRY   Character     13
    2  MODE        Character      4
    3  PRGNAME     Character     80
    4  ORDER       Numeric        2
    5  CMDLINE     Character     80
    6  RPTFILE     Character     80
    7  HELP        Character     40
** Total **                     300
```

Example report listing the contents of MODELS.dbf

```
---------------------------------------------------------------------------------------------------------------------
Text to        Text  Name and Drive            Command line syntax          Name and drive location    Help message to
appear in      or    location of               used to invoke the           of the appropriate         display to screen
Menu Entry     Graph program that              nominated program            report file
               Mode  effects command
---------------------------------------------------------------------------------------------------------------------
CanHelp        TEXT  CANHELP                                                                            Switch to using CanHelp Model
USLE           TEXT  USLE.EXE                                                                          Model not yet available (use CanHelp)
---------------------------------------------------------------------------------------------------------------------
```

The three files detailed above (COVERAGE, REPORTS, MODELS) permit WSIS to be changed or extended with very little additional effort. These dBaseIII+ tables identify to the main program (GRIDS) where to look for data or for external executable programs that act on the data.

The COVERAGE table allows users to identify additional fields of data for display to the computer screen. The only limitation is that the data must occur in an existing (or new) field in the main SIDMAP data table and that it be recorded as integer classes between 1 and 12. This limitation is imposed by the inability of IBM EGA color screens to display more than 12 colors at one time. The COVERAGE file identifies for GRIDS what field to read to display classified data to the screen. The legend entry associated with each of up to 12 classes of data is read from the fields named FIELD1 to FIELD12. A new coverage may be added to the COVERAGE menu simply by editing the dBaseIII+ COVERAGE file and identifying the name of the field in the SIDMAP data table which contains the data to be displayed, the number of categories into which that coverage has been classed, and the legend entry associated with each class or group. Similarily, any coverage can be deleted from the menu by simply removing the record pertaining to it from the COVERAGE data table.

The REPORTS table works in a similar fashion to the COVERAGE table. The main difference here is that the REPORTS table is used to identify the name and location of executable programs used to add data to the main data base or to locate, extract and create reports of data based on linkages between the soil series codes appearing in the main SIDMAP data table and the additional soils data stored in the related soil names file (SNF) soil layer file (SLF) and soil conservation problem file (SOILCONS). The programs used to locate data and format reports are written in dBaseIII+ language and compiled using CLIPPER (TM). It is possible to add new reports or change the appearance or content of existing reports by writing new CLIPPER programs or editing the existing CLIPPER programs. Anyone familiar with simple dBase III+ programming can make these changes or write new programs. Adding or deleting report programs from the menu is done by editing the contents of the REPORT table in a fashion similar to that described for the COVERAGE table. Output from the report programs is sent to the text file identified in field 6 (RPTFILE). Placing the output from a query into an ASCII text file makes it easier to both display the results of a query to the screen and send the formatted report to an attached printer, if desired.

The MODELS table was included to permit future developments of WSIS. At present, there are no models implemented under the umbrella of the WSIS system. It is entirely feasible to capture the logic of models like USLE and CanHelp in CLIPPER programs that could be executed from within WSIS/GRIDS. The CLIPPER versions of these programs could be written so as to extract and use any of the required soils data already recorded for the quarter section in the existing SIDMAP and soil layer file tables. Any required data not included in the existing data bases could be input on-screen for a given 1/4 of interest. Any reported soils data considered to be incorrect or suspect could be changed to reflect on-site inspections. The result would be a seemless integration of existing models with available data supplemented with on-site observations. The important feature is that WSIS and GRIDS are designed to accommodate such possible extensions and improvements.

Appendix A:

Documentation and Citation of Data Sources used in WSIS

1) SIDMAP data originated from a co-operative compilation of existing soils data by Agriculture Canada and Alberta Agriculture. The data are now housed and managed by the Alberta Research Council, Environmental Research and Engineering Department. Data contact person: Brenda Sawyer, ARC.
Reference: Hiley, J.C., G.T. Patterson, G.K. Peterson, W.W. Pettapiece and R.L. Wehrhahn. 1986. SIDMAP: Soil Inventory Database for Management and Planning: Development, Applications and Evaluation. AIP No. M-86-1. University of Alta., Edmonton.

2) Warner Soil Names File (SNF) data were extracted from the SIDMAP Soil Names File (SNF) assembled and managed by Agriculture Canada, Centre for Land and Biological Resource Research, Alberta Unit. These data are in the process of a major reorganization and update which will introduce changes to the present data file. Data contact person: J. Tajek, Agriculture Canada.

3) Warner Soil Layer File (SLF) data were extracted from the Alberta version of the Soil Names File produced and maintained for CanSIS by Agriculture Canada, Centre for Land and Biological Resource Research, Alberta Unit. Data Contact person: J. Tajek, Agriculture Canada.

4) Estimates of potential soil erosion by section were obtained from the SOILEROS database prepared by Agriculture Canada, Centre for Land and Biological Resource Research, Alberta Unit, through application of the USLE equation to the SIDMAP database.
Reference: Tajek, J., W.W. Pettapiece and K.G. Toogood, 1985. Water Erosion Potential of Soils in Alberta. Agric. Can. Tech. Bull. No. 1985-29, Ottawa.

5) Estimates of potential aridity were obtained from the SOILARID database of soil moisture limits and aridity data prepared by Agriculture Canada, Centre for Land and Biological Resource Research, Alberta Unit, using SIDMAP soils data and regional climatic data.
Reference: Tajek, J., W.W. Pettapiece and K.G. Toogood, 1989. Water Supplying Capacity of Alberta Soils. LRRC Publ. 89-117, AIP Publ. M-89-2.

TRANSALTA UTILITIES TREE SELECTION SYSTEM FACTSHEET

CONTACTS

Hugo Shaw
Supervising Forester
TransAlta Utilities Corporation
110-12th Avenue S.W.
Box 1900
Calgary, Alberta
T2P 2M1

☎ (403) 267-7264 (fax: 267-7415)

MODEL OBJECTIVE

To improve TransAlta's quality of customer service by assisting in the selection of the "right" tree or shrub for our customers.

MODEL COMPONENTS

- ☆ A database of 300 different trees and shrubs that will grow in Alberta.
- ☆ A selection criteria of 22 different plant, site and geographic characteristics.
- ☆ A series of graphic screens and icons to define the selection criteria.
- ☆ A set of 300 full color information cards that have additional information and pictures of each tree and shrub in the database.
- ☆ A technical Users Handbook for the Tree and Shrub Guide.

MODEL OPERATION

A PC based system, users can ask for information about specific tree or shrubs in the database. Users can also define specific plant, geographic and site criteria and quickly search the database for the appropriate trees or shrubs.

HARDWARE REQUIREMENTS

- ☆ IBM AT, IBM XT or compatible with at least 640 K RAM (operation slow on XT models); DOS (Disk Operating System) software.
- ☆ Fixed drive or 1.2 M floppy drive. Operation not possible from a 360 K floppy drive. Installation to fixed drive highly recommended.
- ☆ EGA (enhanced graphics adapter) or VGA (video graphics adapter) required.
- ☆ Two-button Microsoft mouse or three button Logitech mouse.
- ☆ Improved performance with EMS (expanded memory system) and an EMM.SYS (expanded memory manager driver).
- ☆ IBM or compatible printer.

NITROGEN BEHAVIOUR SIMULATION MODEL FACTSHEET

CONTACTS

Ron Bertrand or Geoff Hughes-Games
Soils and Engineering Branch
33832 South Fraser Way
Abbotsford, British Columbia
V2S 2C5

☎ (604) 852-5363

MODEL OBJECTIVE

To simulate nitrogen behavior from the time it leaves the animal as manure until it enters the soil and is taken up by a crop, is lost to the environment, or becomes a component of soil organic matter.

MODEL COMPONENTS

The model is written in Fortran and consists of four submodels: crop growth, soil nitrogen balance, subsurface mass transport, and manure nitrogen production. The program calculates on a weekly basis: crop dry matter content, crop nitrogen content, total ammonium and nitrate content in the root zone, total inorganic nitrogen available to the crop, and nitrogen losses through leaching, volatilization and denitrification. The soil moisture profile and water movement are simulated on a daily basis and used in the submodels for crop growth, mineralization, nitrification, denitrification and leaching.

MODEL OPERATION

The input and output interfaces to the model use Microsoft Excel version 2.1. Input consists of 4 types of files: manure type, soil characteristics, climate and crop. Additional inputs include: rate of nitrogen, irrigation schedule, and crop planting and harvest dates. Model output can be displayed in either graphical form or in spreadsheet tables. An expert system is being developed for use in interpreting the output.

APPLICATIONS

The model was developed to provide a method to assess nitrogen movement and changes in distribution which result from different farm practices, climates, soils and crops. The model provides users with guidance on manure management practices to minimize the potential for environmental contamination.

USERS

The model in its current form is best suited to "expert" users. That is, users should have a good understanding of nitrogen behavior, soil processes, and manure management practices. The expert system, when available, will make the model more suitable for use by non-experts.

HARDWARE REQUIREMENTS

IBM 386 or true compatible; Intel 80387 math coprocessor two megabytes of RAM

NITROGEN BEHAVIOR SIMULATION COMPUTER MODEL

by
Rick Van Kleek

The model simulates nitrogen behavior from the time that it leaves the animal as manure until it enters the soil and is eventually taken up by a crop, lost to the environment or becomes a component of soil organic matter. The model consists of four parts: manure transformations during collection, storage and spreading; soil processes; crop growth; and water movement through the soil.

Four categories of input information are required from the user: manure type and characteristics, soil type, climatic parameters and crop type. This information is used by the model to predict the following: crop yield, crop nitrogen uptake, organic nitrogen mineralization, and nitrogen losses due to volatilization, leaching and denitrification. The model can be used to assess manure management practices to determine effect on crop production and the potential for environmental contamination.

FERT92 FACTSHEET

(Irrigated Crop Fertilizer Recommendation Program)

CONTACTS

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T1J 4C7

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T6H 5T6

☎ (403) 427-2530 (fax: 422-9745)

MODEL OBJECTIVE

FERT92 assists with the selection of irrigated crop fertilizer recommendations, based on soil analyses, crop, irrigation level and economic principles.

MODEL COMPONENTS

Irrigated crops; Irrigation level; Soil analyses data; Crop prices and fertilizer N costs; Crop response model to added nitrogen fertilizer; Estimation of optimum Nitrogen fertilization based on marginal return; Recommendations for P, K and S; Interpretation guidelines for micro-nutrients

MODEL OPERATION

- ☆ Selection of crop, previous crop type and irrigation level
- ☆ Input of laboratory soil test data
- ☆ Input of fertilizer nitrogen costs and expected crop prices
- ☆ Calculation of crop yield response to applied N fertilizer
- ☆ Calculation optimum fertilizer N, P, K and S rates
- ☆ Interpretation of micro-nutrient soil test levels

APPLICATIONS

- ☆ Fertilizer management planning
- ☆ Soil fertility research
- ☆ Education

USERS

- ☆ Producers
- ☆ District Agriculturists
- ☆ Fertilizer agents, dealers and manufactures
- ☆ Soil specialists
- ☆ Researchers

HARDWARE REQUIREMENTS

- ☆ IBM-PC or compatible with minimum 640K RAM and MS-DOS 2.0 or higher

FERT92
Irrigated Crop Fertilizer Recommendation Program

L.M. Kryzanowski and R.H. McKenzie
Soils Branch, Alberta Agriculture

Introduction

The decision by a farmer regarding the best crop to grow and the optimum rate of fertilizer is based on a number of factors including the farmer's experience, soil test recommendations, the cost of fertilizer and the expected price for the crop. Soil testing and laboratory soil test recommendations provide a reliable basis for making crop/fertilizer decisions, but may not have sufficient and timely information for the farmer to make his final decision. FERT92 provides a means for the farmer to adjust his fertilizer requirements based in his individual operational management and risk.

Objective

The purpose of the FERT92 software is to provide the user with a tool to calculate fertilizer requirements for irrigated crops, based on soil analyses, crop selection, irrigation level and economic principles. With FERT92, the user has the opportunity to test various crop choice/fertilizer cost/crop price combinations interactively prior making a final decision.

Development Background

FERT92 was developed based on irrigated crop research for southern Alberta. Approximately 76 site-years (1982 - 1987) of data was used to develop equations for crop response to applied nitrogen fertilizer and calibrate soil test for fertilizer recommendations. Results were published in the Farming For the Future report "Development of fertilizer recommendations for irrigated grain and oilseed crops in southern Alberta (Farming For the Future, 1989), R.H. McKenzie, L.M. Kryzanowski and J. Carefoot". Additional model designs are based on the " Soil test recommendations for Alberta: Technical manual (Soils Branch, 1988), L.M. Kryzanowski (ed.)" and the soil test recommendation computer system of the Agricultural Soils and Animal Nutrition Laboratory of Alberta Agriculture.

Model Theory and Assumptions

A number of assumptions have been made in the development of the crop response equations and the soil test recommendations, and the design of FERT92, including:

- Crops respond equally to soil and fertilizer nitrogen.
- Yield equations were developed for three irrigation levels: average, intermediate and optimum.
- Moisture is not considered restrictive for the optimum irrigation.
- A legume crop grown in the previous year will replenish some nitrogen for subsequent crops.
- The yield model is based on soil nitrogen data for soil sampled to a depth of 60 cm. For shallow sampled soils, the NO_3-N to a depth of 60 cm is estimated.
- Phosphate and potash fertilizer recommendations are based on the soil test phosphorus and potassium level of the 0-15 cm sample depth.
- Sulphur recommendations are based on soil sulphur data for soil sampled to a depth of 60 cm. For shallow sampled soils, the SO_4-S to a depth of 60 cm is estimated.
- Micronutrient soil test interpretations are based on 0-15 cm sample depth.

Model Components and Operation

The model for FERT92 can be broken down into 4 components: a) soil analysis, b) crop response, c) economic analysis, d) calibrated soil test recommendation, and e) micronutrient level interpretations.

a) soil analysis.

The soil analysis data that is entered into the model is converted to a standard basis. Data can be entered as either parts per million (ug/g) or as lb/ac. Correction for sampling depth and laboratory method are made to the data prior to model processing for fertilizer recommendations.

b) Crop response

Regression techniques were used to fit a mathematical equation to express crop yield as a function of soil test nitrogen (SN) and fertilizer nitrogen (FN) application for three possible irrigation levels . A hyperbolic equation of the following form is used in the model:

$$Y = Ns / (b_0 + b_1(Ns))$$

where: Y = yield (kg/ha)

$Ns = NO_3$-N (0-60 cm) + Fertilizer N applied (kg/ha)

b_0, b_1 = regression coefficients

Yield and fertilizer application rates are converted from metric to imperial units.

Once the desired crop to be grown and the irrigation level is selected, FERT92 calculates the crop yield response for each 10 lb increment of nitrogen per acre.

c) economic analysis

The rate of fertilizer applied to each field is a management decision that should be based on economic factors and the objectives of the farm business. The main considerations are the yield production level to be achieved and the available capital that can be invested in fertilizer application. To help with this decision, FERT92 provides predicted yield increase data. The expected economic or net return from fertilizer is determined by the difference between fertilizer cost and expected crop price. The "yield increase" data can be used to estimate expected net returns and provide a guide to determining a desirable rate of fertilizer application specific for the producers requirement.

Marginal analysis can be used to determine the profit-maximizing rate of fertilizer nitrogen application by comparing the marginal costs (MC) of nitrogen fertilizer with marginal returns (MR) from crop yield increases to determine either expected net return (MR - MC) or investment ratio (MR/MC). It is profitable to increase yields by adding nitrogen fertilizer as long as marginal returns exceed marginal costs. Accordingly, maximum profit is achieved when marginal returns equals marginal costs or when the investment ratio equals 1.0. Applying additional nitrogen fertilizer would cause profitability to decline. However, since there are risks and uncertainties of crop production and crop prices, it is better to choose a level of fertilization where marginal returns are 1.5 - 2.0 times greater than marginal costs.

FERT92 allows the user to enter nitrogen fertilizer costs and expected crop prices to calculate marginal costs and marginal returns for each nitrogen fertilizer rate and yield increase and identifies the rate of nitrogen fertilizer that provides a MR:MC ratio of 2:1.

d) calibrated soil test recommendations

For phosphate, potash and sulphur recommendations, calibrated soil test functions are used. These functions are specific to each crop type.

$$REC = MAX - (b_1 * ST)$$

where: REC = P_2O_5, K_2O or S recommendation (lb/ac)

MAX = Maximum P_2O_5, K_2O or S recommendation (lb/ac)

b_1 = soil test calibration slope

ST = Soil test level for P, K or S (lb/ac)

e) micronutrient level interpretation

Specific micronutrient recommendations are not provided, instead an indication of whether the soil test level of each micronutrient is adequate, marginal or deficient.

Future Development

Currently, FERT92 is being tested by various district agriculturists in southern Alberta, but a number of enhancements for the FERT92 software are being planned to improve and expand its application, including:

a) expansion of the program to include dryland crops for various spring soil moisture conditions plus regional growing season precipitation probabilities,

b) micronutrient recommendations based soil test calibration research,

c) the effect of timing and depth of soil sampling on soil test levels and fertilizer requirements,

d) the effect of soil pH and salinity levels on crop production and fertilizer requirements,

e) the effect of manure application and forage plowdown on soil test levels and fertilizer requirements,

f) the effect of fertilizer placement (method and time of application) on fertilizer use efficiency, potential seeding damage and fertilizer requirements,

g) the effect of cropping systems and rotations,

h) expansion of the economic analyses to include other fertilizer nutrients besides nitrogen,

i) calculations for blending of fertilizer materials to satisfy nutrient recommendations,

j) expansion to include diagnosis of problem conditions based on crop symptoms, soil analyses, tissue analyses, management and geographical database information such as soil classification and agro-ecological information.

Many of these proposed enhancements will require extensive field and laboratory research.

RESMAN FACTSHEET

(RESidue MANagement decision support program)

CONTACTS

Dr. Diane E. Stott
USDA-ARS, National Soil Erosion Research Laboratory,
Purdue University, SOIL Bldg.
West Lafayette, Indiana ·47907

☎ (317) 494-6657

In Alberta Contact:

Tom Goddard
Conservation and Development Branch,
Alberta Agriculture,
#206, 7000-113 St.
Edmonton, Alberta T6H 5T6

☎ (403) 422-6530 (fax:422-0474)

MODEL OBJECTIVE

RESMAN was developed to assist a producer to select appropriate tillage management to increase the level of residue left at the soil surface.

MODEL COMPONENTS

Crop residue generation, residue retention factors of tillage implements, weather data, overwinter residue decomposition, mass vs percent cover conversion.

MODEL OPERATION

- Select crop from list of 21 choices.
- Set fall residue level, or it is calculated from yield data.
- Set harvest date and subsequent planting date.
- Select fall and spring tillage implements, seeding implement.
- Select climate file.
- Calculates residue retained on the soil surface after tillage, seeding and overwinter weather.

APPLICATIONS

- Tillage management planning
- Water erosion planning
- Wind erosion planning
- Moisture conservation planning
- Decomposition routines are now used in WEPP, WEPS and RUSLE

USERS

- USDA researchers and extension staff
- Conservation and Development Branch and Field Services, Alberta Agriculture
- **Reference:** Stott, D.E. 1991. RESMAN: A tool for soil conservation education. JSWC 46(5): 332-333.

HARDWARE REQUIREMENTS

- A minimum of an IBM-PC or compatible with monochrome monitor, 128K RAM and MS-DOS 2.0 or higher.

RESMAN
RESidue MANagement Decision Support Program

by
Tom W. Goddard
Alberta Agriculture

In the mid 1980s the Agriculture Research Service (ARS) of the United States Department of Agriculture (USDA) initiated two new programs using the latest technology and research results. One is a water erosion prediction project (WEPP) and the other an expert systems development for technology and resource conservation in agriculture (EXTRA). Agronomic research in the 1980s provided more insight into mechanistic and empirical models relating to residue decomposition (1,4). More recent research has indicated that residue decomposition losses are quite different than previously accepted estimates (2). RESMAN was developed as part of EXTRA and its' residue decomposition model has now been incorporated into WEPP as well as other water and wind erosion models.

RESMAN estimates the amount of residue left in one year depending upon crop type, decomposition of the residue and burial of residue by tillage and seeding practices. The program is simple, easy to use, has on line help and why screens and comes with a comprehensive manual. Interactive screens take the user from fall to spring selecting the appropriate crop, tillage and climate. The program can be re-run to change selected variables to examine various what if scenarios.

The program contains interactive windows which can be grouped as follows:

1. Determine initial residue in the fall.

    - select the crop from a list of 20
    - provide residue amount or program calculates it
    - set desired residue coverage next spring

2. Select fall tillage used.
    - select primary and secondary tillage implements and number of passes from a list of 20

3. Determine harvest to seeding residue decomposition.
    - provide harvest and seeding dates
    - select appropriate climate file for program calculations. Alberta climate files are provided for 22 locations.

4. Select spring tillage and planter used.
    - select spring tillage and number of operations from a list of 20 implements. Eleven options for planter choices.

5. The result.
    - the amount of residue left on a field after seeding on a mass and percent cover basis.

The simplicity of the program operation, the completeness of the associated documentation, on-line assistance and the ability to re-run scenarios increase the usefulness of RESMAN as an educational tool (3). RESMAN does not link residue amounts to any erosion models. Thus, extension agents can use the program to emphasize residue management for water erosion, wind erosion or moisture conservation. When efforts are made to keep a program simple, sacrifices in detail are often encountered. A summary of some of the pros and cons are:

PROS:

- Excellent manual
- On-line help and why boxes
- Quick to learn and easy to use
- No need for specialized information input
- Good selection of equipment and crops
- Only program around that estimates decomposition
- Prints a simple report

CONS:

- Assumes constant tillage speed, average depths, flat field, average soil texture and moisture
- Only looks at one year at a time
- Assumes spring planting (but it can be tricked)
- Residue X yield relationships are averages for crops. There may be varietal differences.

Future modifications to RESMAN are planned for Alberta. The equipment lists will be made more applicable to Alberta and residue retention factors reviewed.

RESMAN is a simple, easy program to illustrate the effect of crop choice and tillage management upon residue coverage. It will run on a small DOS type computer with a monochrome screen and it is available at no charge. See the factsheet for further details and contacts.

REFERENCES

1. Stott, D.E., L.F. Elliott, R.I. Papendick, and G. S. Campbell. 1986. Low temperature or low water potential effects on the microbial decomposition of residue. Soil Biol. Biochem. 17: 577-582.

2. Stott, D.E., H.F. Stroo, L.F. Elliott, R.I. Papendick, and P.W. Unger. 1990. Wheat residue loss from fields under no-till management. Soil Sci. Soc. Am. J. 54: 92-98.

3. Stott, D.E. 1991. RESMAN: A tool for soil conservation education. J. Soil and Water Cons. 46(5):332-333.

4. Stroo, H.F., K.S. Bristow, L.F. Elliot, R.I. Papendick, and G.S. Campbell. 1989. Predicting rates of wheat residue decomposition. Soil Sci. Soc. Am. J. 53: 91-99.

ELLY FACTSHEET

(Encyclopedia for Landscape and Land-indexed Inquiry)

CONTACTS

Joe Tajek - Agriculture Canada, Edmonton, Alberta - 495-6121

Keith Toogood - Alberta Agriculture, Edmonton - 427-2101

Tomislav Milinusic - Axion Spatial Imaging, Edmonton - 488-3565

MODEL OBJECTIVE

Provide database management capabilities with low-end geographic information system functionalities.

MODEL COMPONENTS

Input, Display, Statistical Analysis, Boolean operators, Map and Tabular Output

MODEL OPERATION

- ✩ select database
- ✩ select variable(s)
- ✩ geographic dispay of selections
- ✩ select appropriate statistical analysis
- ✩ subset on basis of statistical analysis using boolean operators
- ✩ map and tabular output

APPLICATIONS

Research, Policy Development, Program Implementation

USERS

Researchers, Policy Planners, Program Administrators, Farmers

HARDWARE REQUIREMENTS

Contact Tomislav Milinusic

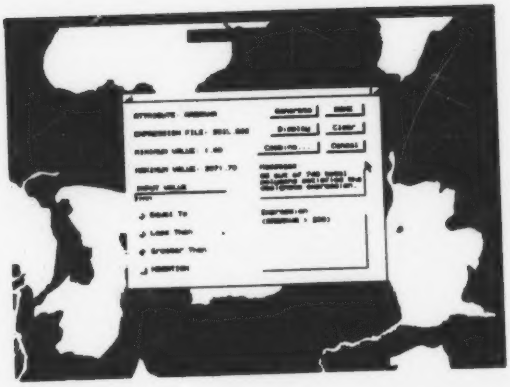
***ELLY** is one of the first Geographic Information Systems specifically designed for the management and seamless integration of soil information. It is able to answer a large number of queries and hypothesis based on powerful spatially extracted information from databases of the 1:1,000,000 Soil Landscapes of Canada Series, as well as the Prairie provinces' SIDMAP-like databases at the quarter-section level. It was designed for Agriculture Canada uses.*

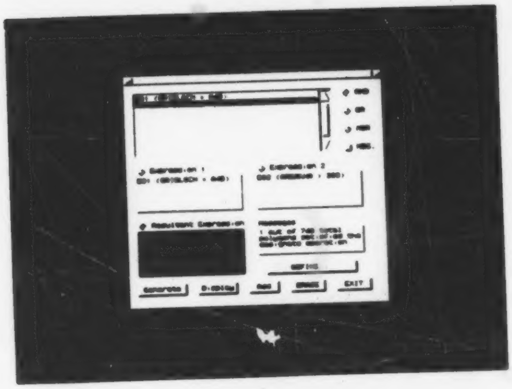
***ELLY** can assist:*

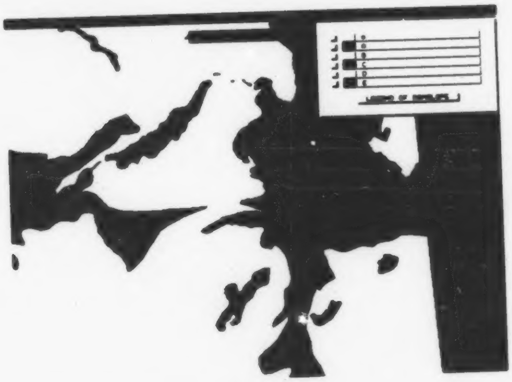
- ☐ **Soil Scientists**
- ☐ **Policy Planners**
- ☐ **Program Administrators**
- ☐ **and Farmers**

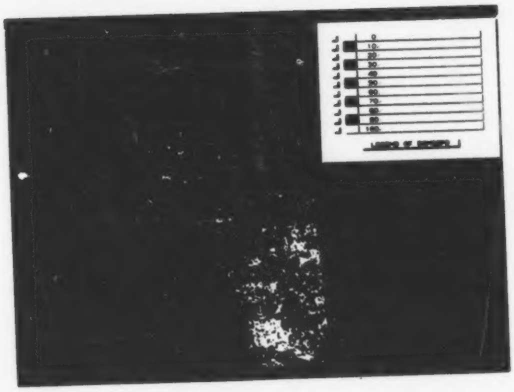
***ELLY** can be used in research, policy development and program implementation by intelligently querying, subsetting, analyzing and modeling complex data series in a graphical environment. Its analysis scope covers many scales from 1:250,000 to 1:5,000,000 in one PC-based software.*

These operations take only a few seconds to compose, process and display via an intuitive and easy to use pull-down menuing interface. You are only mouse clicks away from the answer. There is next to no keyboarding required.









Some Characteristics of the System:

SOFTWARE

- The system is menu and mouse driven. It is also object oriented so that the need to memorize commands is eliminated, and touching items on the map will elicit database responses.
- You can select any area of a province and zoom in and out to any level of detail.
- Statistical tools work on all or part of the defined data set.
- Modelling tools to subset and extract data on demand is highly modular, permitting complex queries superior to SQL. This allows management to display outputs of formal and informal thesis through a visual and responsive strategy, and to prepare information for presentation purposes.
- The system is extensible in that new databases can be added, as well as new cartographic data structures. Import of DLG3 files and export to DBase files is available.
- Contemporary Motif-like Graphical User Interface (GUI) to access and interrogate databases
- Geographic Information System capabilities such as polygon overlay processing (POP), Choropleth mapping and layering by data feature.
- Cursor can display the quarter-section legal description in Alberta in real-time.
- Legend annotation with immediate color lookup modification using combination of foreground, background and patterns
- Layered data features with full control of the separate map themes
- Tabular and screen dump with annotations.
- Multi-levelled Boolean operations with Subsetting by regions, variables or themes
- Full editing and automated modification of variables and attributes.
- Choropleth mapping and printing on laser printers
- Context-sensitive help available
- Graphic images saved for display in slide show both internally and externally
- Fully user reconfigurable menuing and color options

HARDWARE

- Runs on AT, 386 and 486 platforms. Optional Unix, Macintosh version available on request.
- Supports for over 200 types of monitor/card resolution from EGA to 1280x1024 and 1600x1200 in B&W
- Supports over 300 types of color printers, black and white printers, and laser printers

The Soil Landscapes data for each province can be obtained from Agriculture Canada . For Western Canada, SID-MAP-like data sets can also be obtained from the appropriate provincial departments of Agriculture.

Copies of the software may be purchased from

Axion Spatial Imaging Ltd.
Suite 301, 10240-124 St.
Edmonton Alberta T5N 1V3
Tel: (403) 488 3565 . Fax: (403) 488 3889

WATERSH FACTSHEET

(Watershed Hydrological Modelling Utilities)

CONTACTS

R. MacMillan
Alberta Research Council, ERED
P.O. Box 8330, Station F
Edmonton, Alberta
T6H 5X2

☎ (403) 438-7516 (fax: 430-0839)

W.P.A. Van Deursen
Department of Physical Geography
University of Utrecht
P.O. Box 80.115
3508 TC Utrecht, Netherlands

☎ (Phone)31-30-532044

MODEL OBJECTIVE

To determine the geometry controlling the directions of overland flow of surface water runoff and compute the location, extent, volume and depth of depressional storage in non-integrated landscapes of low relief.

MODEL COMPONENTS

- ☆ Regular gridded matrix of elevation data (DEM)
- ☆ Interactive graphic environment for computing a) flow direction, b) upslope area, c) catchment extent, d) location of depressions, e) volume to fill depressions, f) connectively between depressions.
- ☆ Semi-automated procedures for identifying and characterizing nested depressions, unblocking pits (pit removal) and defining drainage networks.

MODEL OPERATION

- ☆ Read in DEM.
- ☆ Compute drainage directions, flow paths, catchment areas, upslope area.
- ☆ Write out pit list documenting location, volume, area, depth and connectivity of all 1st order depressions.
- ☆ Interactively unblock pits according to connectivity working from lowest-highest pits.
- ☆ Build external "pit list" table with all pit statistics updated after each pit is "removed".

APPLICATIONS

- ☆ Determine extent of area contributing runoff to any point in catchment or watershed area.
- ☆ Determine size, location, depth and volume for all depressions.
- ☆ Determine geometry of overland flow (flow directions).
- ☆ Simulate drainage paths and stream networks.

USERS

- ☆ MacMillan for Ph.D., Van Deursen for Ph.D.
- ☆ University of Utrecht (contract work), ARC (For Can. Ag.)
- ☆ Very similar programs are in use at Dept.'s of Soils Science and Geography at University of Saskatchewan and University of Alberta.

HARDWARE REQUIREMENTS

- ☆ IBM PC/AT (286) or higher processor with EGA video board and EGA color monitor; 640 K RAM <500 K disk space for programs; 1-2 MB disk space for data
- ☆ Recommended: mouse, math coprocessor

DISTHMOD FACTSHEET

Distributed Infiltration Stores for Topography controlled Hydrological Modelling of Depressions

CONTACTS

R.A. MacMillan
Alberta Research Council, ERED
P.O. Box 8330, Station F
Edmonton, Alberta
T6H 5X2

☎ (403) 438-7516 (fax: 430-0839)

MODEL OBJECTIVE

To simulate overland flow and ponding of surface water runoff in non-integrated landscapes at a farm scale.

MODEL COMPONENTS

- Database of hourly meteorological data (rainfall, radiation, wind, temp, rh).
- Database of distributed grid cell data indexed on catchment area by decreasing elevation by increasing upslope area for a farm sized area.
- Database of soil physical and hydrological properties (parameters).
- Submodels for: snowmelt, evaporation, infiltration, drainage, runoff, ponding, pond overflow, output of tables and map data.

MODEL OPERATION

- Preprocess met data to compute potential evaporation.
- Preprocess met data to compute snowmelt for various depths of snow.
- Preprocess DEM to determine flow paths; catchment areas; pit size, volume, location and overspill points; drainsto, upslope area vol-to-first-flood, likely soil type per cell, snow depth, initial H2O.
- Sort cells by catchment, by elevation , by upslope area.
- Process cells in order for water balance/runoff.
- Fill ponds - direct any excess to overspill points.
- Output spatial pattern of pond location, depth and volume as maps and tables.

APPLICATIONS

Used to investigate runoff - ponding at the Lunty research site (results in prep).

Could use to simulate effects of draining/consolidating ponds on likely on and off-farm patterns of runoff and ponding.

USERS

Strictly limited to Ph.D. research by R. MacMillan. Not currently suitable for general release.

HARDWARE REQUIREMENTS

IBM PC/AT (286) with 640 KB RAM - prefer 386 with coprocessor or 486

<500 KB disk space for data files, recommend 3-4 MB extended memory for RAM drive so data files can be loaded into RAM to reduce disk I/O

PROGRAMS FOR MEASURING (WATERSH) and MODELLING (DISTHMOD) DEPRESSIONAL STORAGE OF SURFACE WATER AT A FARM SCALE

R. A. MacMillan
(Alberta Research Council)
and
W. P. A. Van Deursen
(University of Utrecht)

Environmental Research & Engineering Dept.
Alberta Research Council

12/9/91

OUTLINE

1) Background to Development of Programs
2) Objectives of the Programs
   - WATERSH
   - DISTHMOD
3) Program (Model) Components
   - WATERSH
   - DISTHMOD
4) Program (Model) Operation/Derivation
   - WATERSH
   - DISTHMOD
5) Example Applications
6) Proposed Future Developments
7) Hardware & Software Specifications

BACKGROUND - WATERSH

- Developed at University of Utrecht.
- Focus of PhD research project (W.P.A. Van Deursen).
- Meant to demonstrate techniques of surface modelling.
- Meant to provide interactive, user friendly access to algorythms.
- Incorporated published algorythms (Mark et al, Band, Jenson).
- Modified considerably to deal explicitly with "pits".
- Obtained for use in 1989.

BACKGROUND - DISTHMOD

- Wanted to simulate magnitude and extent of ponding.
- Needed to add process to the geometry of WATERSH.
- No existing model permitted depressions (SHE, ANSWERS, CREAMS, IHDM, TOPMODEL).
- Assembled custom model (DISTHMOD) Jan.-Aug. 91.
- Framework for processing based on geometry from WATERSH.
- Processes for water balance based on equations from existing models (ANSWERS, SWATRE, SNOMELT).
- Uses relational model to store and process data.
- Written and compiled in CLIPPER (TM).
- Processes cells top to bottom by catchment, by elevation.
- Records/updates volume of water in pits in separate table.
- Pits overflow, coalesce, divide, disappear with changes in volume.

OBJECTIVES

1) WATERSH

Devise procedures to model the static geometry governing the flow and accumulation of water at a farm scale.

Specifically:

- where will water flow?
- where will it accumulate?
- what are the maximum dimensions for depressional storage? ie. area, volume, depth
- how are ponds and catchments interconnected?
- where will water from a given pond flow once that pond is full to overflowing?

OBJECTIVES

2) DISTHMOD

Devise model to simulate the degree to which depressional storage is full at any given time.

Specifically:

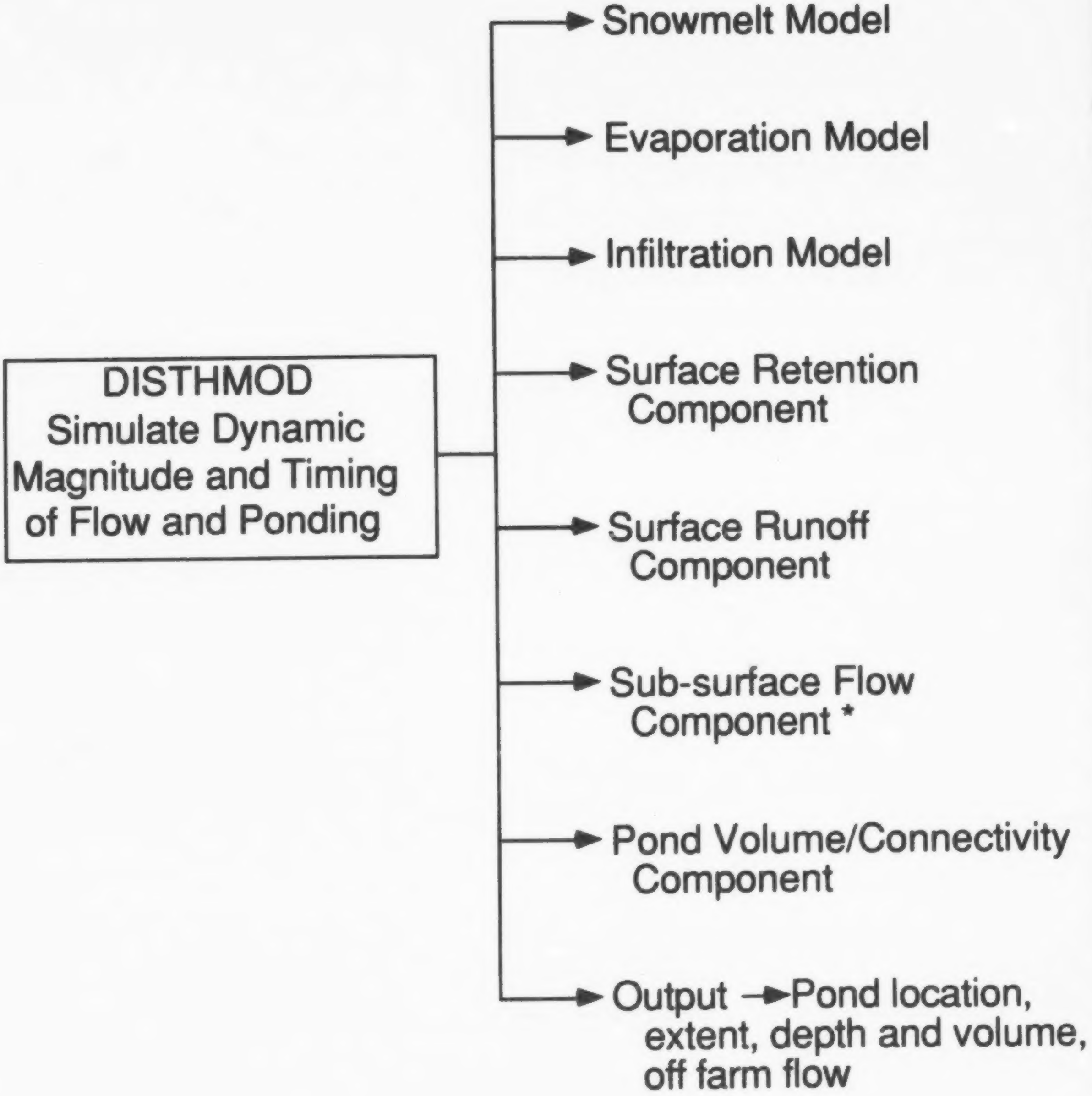
- estimate magnitude and timing of inputs (rainfall, snowmelt).
- estimate the magnitude and timing of losses (evaporation, infiltration).
- estimate the magnitude and timing of spring runoff.
- predict the location, extent and depth of surface water ponding at any given time at a farm scale.

MODEL COMPONENTS

WATERSH
Model Static Geometry of Flow and Ponding

- Flow Directions
- Upslope Areas
- Catchment Areas
- Initial (1st order) Depressions
- Volume to Flood
- Depressional Connectivity
- Nested (2nd order) Depressions
- Additional Terrain Derivitives

MODEL COMPONENTS

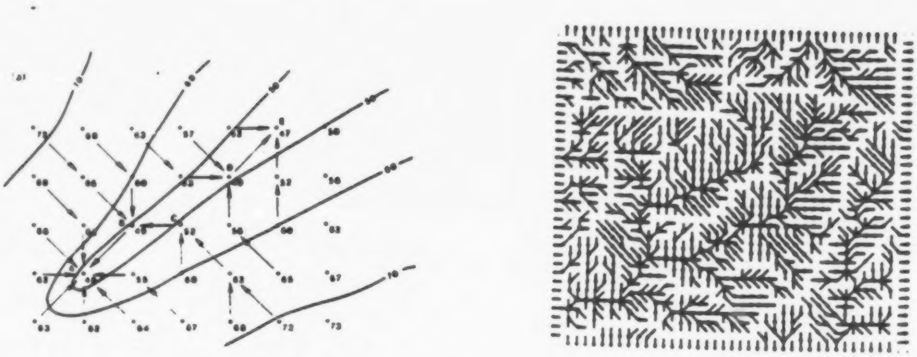


DISTHMOD
Simulate Dynamic
Magnitude and Timing
of Flow and Ponding

- Snowmelt Model
- Evaporation Model
- Infiltration Model
- Surface Retention Component
- Surface Runoff Component
- Sub-surface Flow Component *
- Pond Volume/Connectivity Component
- Output → Pond location, extent, depth and volume, off farm flow

MODEL OPERATION - WATERSH

1) Determine Flow Direction



2) Determine Upslope Area and Catchment Boundaries

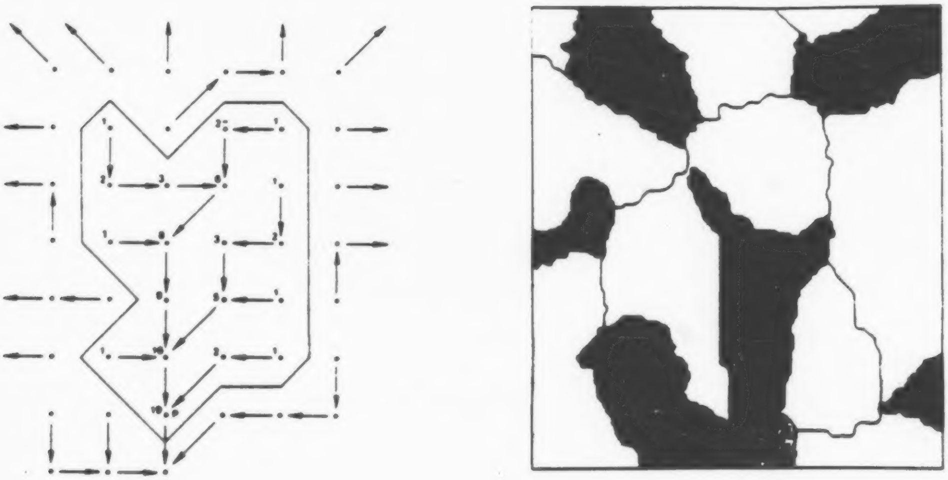
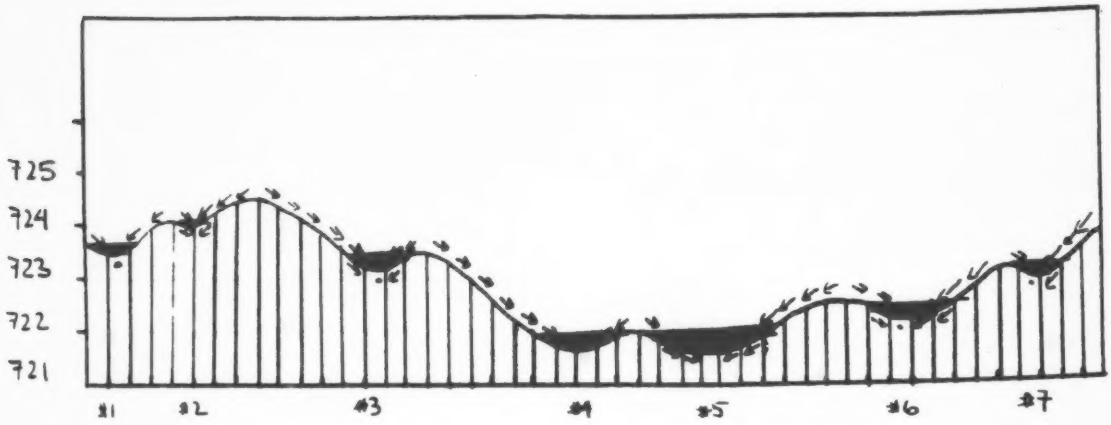


Figure Source: Morris and Heerdegen (1988)

MODEL OPERATION - WATERSH

3) Determine Initial (1st Order) Depressions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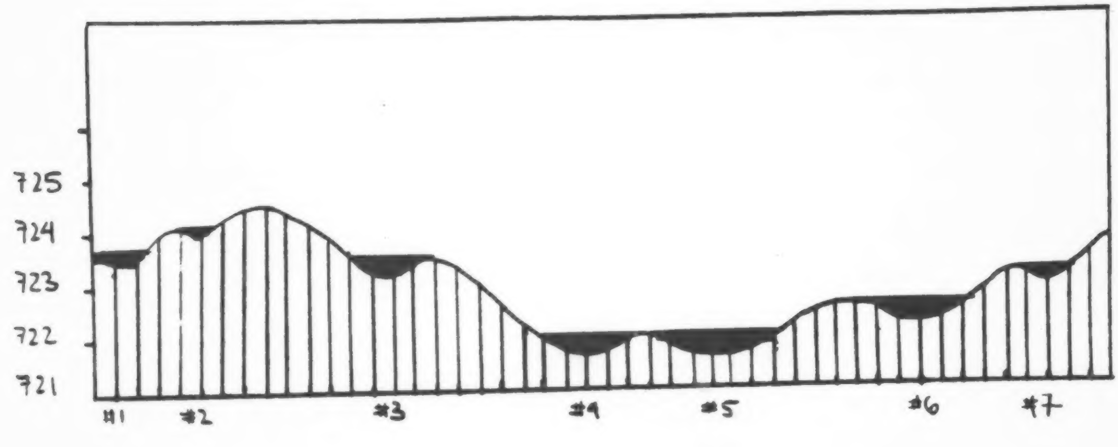
4) Determine Volume to First Flood and Volume When Full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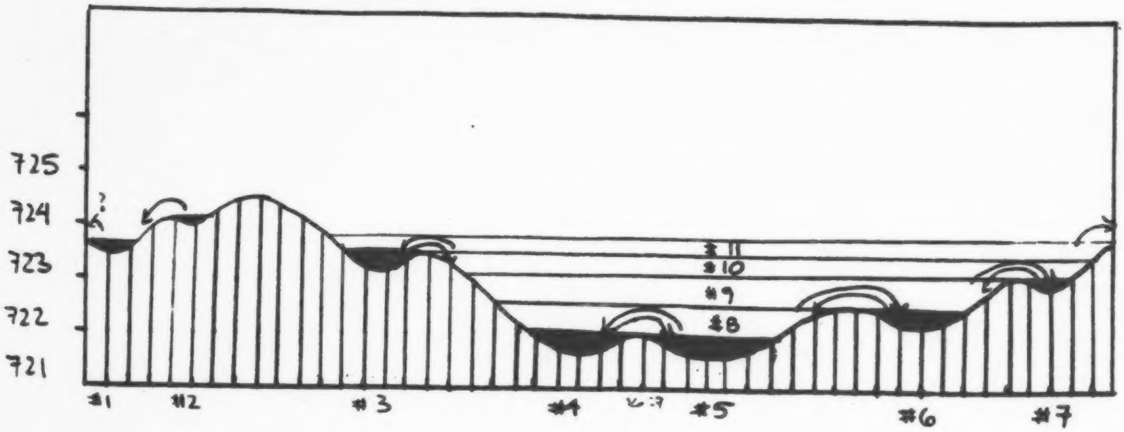
#7

Environmental Research & Engineering Dept.
Alberta Research Council
12/9/91

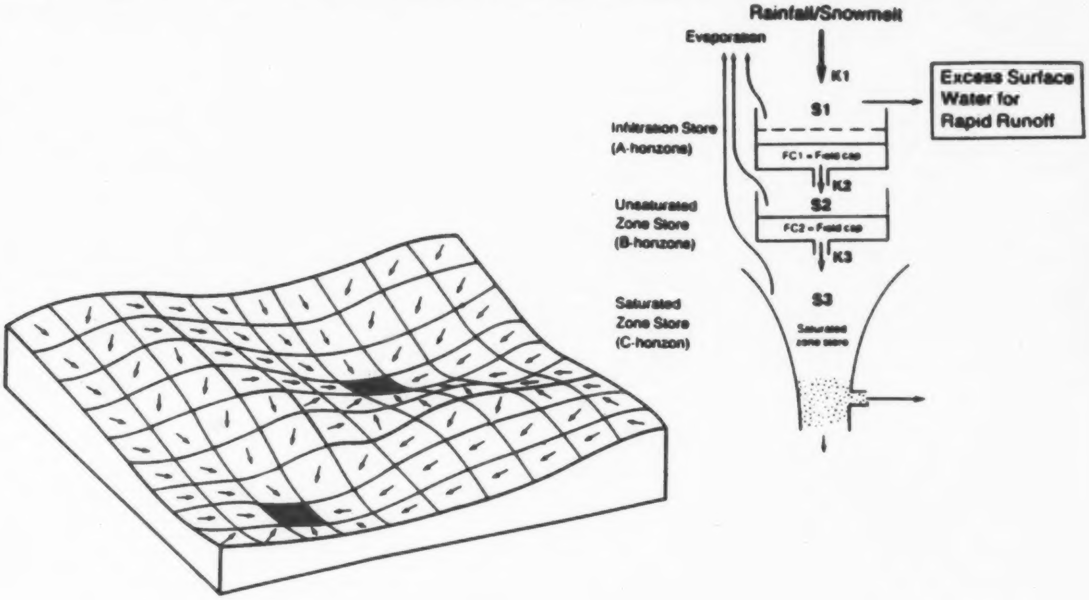
MODEL OPERATION - WATERSH

5) Determine Nested (2nd Order) Depressions and Connectivity



Pond No	Vol To Fill	Pond Area	Pond Depth	Drains To No.	Next Ponding No	Outflow		Pour Elev.	Water-shed Area	V/A Ratio
						Row	Col			
4	1.5m	5	.5m	5	8	10	27	722.0	10	.15
5	2.0m	6	.5m	4	8	10	26	722.0	10	.20

MODEL OPERATION - DISTHMOD


Rainfall/Snowmelt
Evaporation
K1
Excess Surface Water for Rapid Runoff
S1
Infiltration Store (A-horizons)
FC1 = Field cap
K2
Unsaturated Zone Store (B-horizons)
S2
FC2 = Field cap
K3
Saturated Zone Store (C-horizon)
S3
Saturated zone store

1) Input Met Data: RAIN RADIATION TEMP RH WIND CLOUDS
    - Hourly input if rain or snowmelt > 0
    - Summed to max 24 hours if rain or snow = 0
2) Compute snowmelt for different depths: Williams (1988)

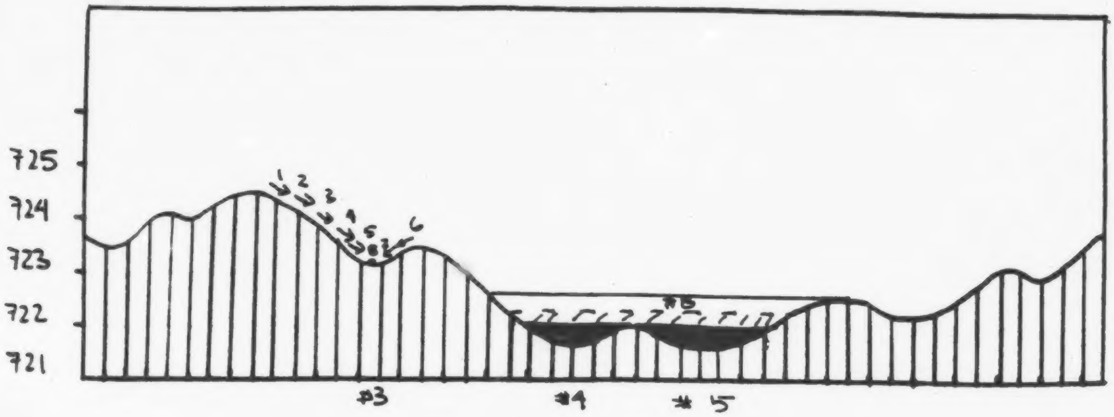
$$\partial S/\partial t = Qs + Qa + Qe + Qh + Qv$$

3) Compute potential evapo-transpiration: Swatre (1983)

$$ET = \frac{\Delta Rn/L + Ea}{\Delta +}$$

4) Compute infiltration and drainage: Answers (1981)
5) Compute surface retention and runoff: Answers (1981)
6) Pass runoff to downslope neighbor

MODEL OPERATION - DISTHMOD



Pond No	Pond Row	Pond Col	Pond Elev	Vol-To-Fill	Vol-In-Pit	Pre Vol	Drains To Pit	Next Pit Up	Visited	Full	Final
4	10	23	721.5	1.5	1.5	0.0	5	8	Y	Y	N
5	10	29	721.5	2.0	2.0	0.0	4	8	Y	Y	N
8	10	29	721.5	7.5	1.0	3.5	6	9	N	N	N

7) Process cells from top down by catchment.

8) At pit cell check Vol-In-Pit + runoff to see if it exceeds storage volume of depression.

9) If NO add new runoff volume to Vol-In-Pit .

10) If YES determine excess and place:
    a) At overspill cell
    b) Into Vol-In-Pit of subsuming depression

11) All excess stored in other pit or placed at overspill?

12) Start at top cell of next lowest watershed.

EXAMPLE APPLICATIONS

1) WATERSH:

- determine extent of area (field) contributing runoff to any given point (Len Leskiw).
- determine location, maximum extent and volume of depressional storage (ephemeral ponds).
- determine connectivity between watersheds and ponds.
- explicitly define point to point routes of flow (flow paths) for surface runoff.
- assess alternate strategies for storage of surface water.

EXAMPLE APPLICATIONS

2) DISTHMOD:

- simulate change in pond volume, area, depth with time.
- estimate change in catchment area contributing flow to any given point as ponds fill up and empty.
- estimate likely extent and timing of farm flow of surface water under different conditions.
- investigate potential changes to on-farm storage or off-farm flow resulting from proposed man made changes to the drainage pattern (ie. drain or consolidate sloughs, add ditches or burms).

PROPOSED / FUTURE DEVELOPMENTS

1) WATERSH

- development uncertain -- programs have been superseded by commercial and public domain packages.
- developer (Van Deursen) now employed by private sector consultant in the Netherlands who use the programs in house but do not distribute them.
- some potential for linking WATERSH and DISTHMOD more seamlessly.
    - WATERSH to read/write data to DBase III+ and files used by DISTHMOD
    - DISTHMOD to use WATERSH to display, plot data and results

PROPOSED / FUTURE DEVELOPMENTS

2) DISTHMOD

- no hard plans for any immediate development.
- will likely use "in-house"at ARC for projects requiring modelling of surface water runoff in non-integrated prairie landscapes (ie. Black Spring Ridge).
- would require considerable effort to upgrade to level where it was suitable for "commercial distribution".
- hope to find client/application that might call for upgrade to commercial standards.
- hope to investigate use of DISHMOD and WATERSH in combination as components of a decision support system (DSS) for farm scale management of surface water.
  - options for farms scale management of surface water
  - predictions of likely responses to options for changes in water distribution

HARDWARE and SOFTWARE SPECIFICATIONS

1) WATERSH

- IBM PC / AT (286)
- EGA Board + color monitor
- 640 K RAM
- < 500 K Disk space for programs
- 1-2 MB Disk space for data
- Recommended: mouse, math co-processor.
- Stand alone, interactive raster system written in turbo pascal.

HARDWARE and SOFTWARE SPECIFICATIONS

2) DISTHMOD

- IBM PC / AT (286) (386 or 486 preferred)
- 640 K RAM
- < 500 K disk space for programs
- 2-4 MB disk space for data
- Recommended: 3-4 MB extended RAM drive
- dBase III+ programs compiled using CLIPPER (TM)
- Require dBase III + to view / edit input files

USERS

1) WATERSH

- MacMillan
- Van Deursen
- University of Utrecht
- Many similarities to programs used extensively at U of S and U of A, Dept. of Soil Science and Geography.

2) DISTHMOD

- not yet suitable for general release.
- demonstrates applicability of concepts and equations.
- needs to be 'repackaged' to be suitable for general use.

PRAIRIE AGRI PHOTO LTD.
FACTSHEET

CONTACTS

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Carman, Manitoba
ROG 0J0

☎ (204) 745-2479

MODEL OBJECTIVE

To demonstrate using a PC, the appropriate use of digitzed aerial infrared photos for agricultural and resource planning.

MODEL COMPONENTS

This is not a software package. It is a demonstration of a very effective use of resource data.

APPLICATIONS

These high quality infrared photos in the digitized image are to be presented in a form which is useful to a wide range of resource planners.

USERS

Municipal planners, conservation groups, land assessors, watershed managers, and topsoil erosion specialists.

HARDWARE REQUIREMENTS

386 PC with minumum 80 mg. of storage and appropriate graphics card.

Spatial Analyst ™

Allowing you to create spatial models from AutoCAD® entities and providing you with the capability to perform spatial analysis with those models...
*...this is the power **Spatial Analyst** gives you.*

Map Creation and Editing
Spatial Analyst allows for the flexible input of data that accounts for rotations, scale, units of measure and various angular types. The mapping tools automatically place text in definable styles and locations. Compass rule, traverse adjustment, bilinear, affine and least squares rubber sheeting adjust map data for best fit. ***Spatial Analyst*** also provides editing routines for entity connectivity.

Coordinate Transformation
Spatial Analyst allows you to track coordinates in different map projections in real time and to translate AutoCAD entities or ***Spatial Analyst*** models from one coordinate system to another coordinate system. 330+ coordinate systems are supported and provided, and users can define and use new coordinate systems. Supported coordinate systems include UTMs, State Planes and Latitude/Longitude. Keyed-in coordinates can also be converted to a defined coordinate system.

Line/Polyline Weeding
Spatial Analyst gives you the ability to weed extraneous vertices from polylines or line strings in drawings or models by specifying a corridor width and the number of look ahead vertices.

Topology Building
Spatial Analyst will build topological polygon models in memory from lines, arcs, polylines and optional user specified attribute blocks as well as build models of entities that do not form polygons. With ***Spatial Analyst***, you have the capability to join lines in a model into polylines, add attributes to models, assign derived attributes to models and save, open, show or draw those models. ***Spatial Analyst*** can derive spatial properties of objects in a model (ie: area and perimeter) as well as identify edges of a polygon in a model, identify neighbors of a polygon and identify polygons left and right of an edge of a polygon. ***Spatial Analyst*** will produce thematic graphics based on a query of model attributes.

Spatial Analysis
Spatial Analyst provides powerful tools for creating a model of buffers generated around points, strings or polygons and for combining models with boolean operations (ie: polygon overlay).

External Database Interface
The ***Spatial Analyst*** database interface performs direct database access to dBase files and Oracle. AutoCAD entities and model entities can be linked directly to records in either of these databases.

User Interface
If you are an AutoCAD user, the ***Spatial Analyst*** screen will look familiar as it works entirely in the AutoCAD environment with no shelling to DOS. The menus follow the same flows as those used to execute AutoCAD commands. The menus are simple and commands are easy to understand. Through pop-down menus, tablet menus or dialog boxes, you have access to base map creation routines as well as analysis functions and conversion routines.

PROJECTIONS MAPPING GROUP

Spatial Analyst™

Technical Overview

Operating Platform	• AutoCAD R.11 386 (DOS) • AutoCAD Sun (UNIX)
Hardware	• 386 and 486 DOS-compatible machines • Sun SPARC Station • All AutoCAD-supported monitors and graphics cards
Input Devices	• All AutoCAD-supported input devices
Output Devices	• All AutoCAD-supported printers and plotters
Import/Export	• Supports DXF and GXF file formats
Minimum System Requirements	• 386/SX 20 MHz DOS-compatible machine • 4 MB RAM VGA monitor and graphics card • Mouse • Dot matrix printer
Recommended System Requirements	• 486 33 MHz DOS-compatible machine • 4 MB RAM • VGA monitor and graphics card • Mouse • Color printer

AUTODESK · REGISTERED · DEVELOPER

sun microsystems

Catalyst
Advantage
Program

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All other brands and product names are trademarks or registered trademarks of their respective companies.

For more information: Contact Projections Mapping Group (403)263-3311
Projections Mapping Group (Alaska) (907)272-8247

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Squire	Jim	County of Stettler No. 6	Agricultural Fieldman	Box 1270	Stettler, Alberta	T0C 2L1	403 742-4441	403 742-1277
Stelkovics	Edie	M.D. of Rocky View No. 44	Conservation Coordinator	P.O. Box 3009, Stn. B.	Calgary, Alberta	T2M 4L6	403 230-1401	403 277-5977
Stushnoff	Richard	Saskatchewan Soil Survey	Soil Surveyor	192 Tucker Crescent	Saskatoon, Sask.	S7H 3H9	306 966-4218	306 966-4226
Tajek	Joe	Agriculture Canada, Soil Survey	Pedologist	6th Fl., 4445 Calgary Tr.	Edmonton, Alberta	T6H 5R7	403 495-6121	403 495-3882

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Timmermans	John	Alberta Agriculture	Soil Conservation Spec.	Ag. Regional Centre,Bag 1	Airdrie, Alberta	T4B 2C1	403 948-8539	403 948-2069
Toogood	Dr. John A.			243 Oeming Road	Edmonton, Alberta	T6R 1M3	403 430-7510	
Travis	Greg	Agriculture Canada, Research Br		Agriculture Centre	Lethbridge, Alberta	T1J 4B1	403 327-4561	
Turnbull	Jim	Alberta Environment		9th Fl,9820-106 Street	Edmonton, Alberta	T5K 2J6	403 427-2375	403 422-4190
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Wells	Russell	Alberta Forestry,Lands&Wildlife	Research Officer	10845-32A Avenue	Edmonton, Alberta	T6J 3B8	403 427-0708	403 422-0712
Wentz	Don	Alberta Agriculture	Soil Salinity Specialist	Agriculture Centre	Lethbridge, Alberta	T1J 4C7	403 381-5153	403 381-5765
Wettlaufer	Bob	PFRA	Director, Conserv. Servic	1901 Victoria Avenue	Regina, Saskatchewan	S4P 0R5	306 780-5105	306 780-8229
Williams	Peter	Prairie Agri Photo Ltd.	Consultant	292 Main Street S.	Carman, Maitoba	R0G 0J0	204 745-2479	204 745-2141
Willsey	Dale	Alberta Forestry,Lands&Wildlife	Regional Manager	10320-99th Street	Grande Prairie, Ab.	T8V 6J4	403 538-5260	403 538-5442
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Wood	Craig	PFRA	Area Soil Conservationist	203 Federal Building	Lethbridge, Alberta	T1J 0N8	403 382-3100	403 382-3198
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